The Department of Defense

DoD DEPARTMENTS/AGENCIES:

Department of the Army

Department of the Navy

Department of the Air Force

Advanced Research Projects Agency

Defense Nuclear Agency

BMDO Ballistic Missile Defense Organization

Special Operations Command

SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR)

FY 1993 SBIR SOLICITATION

PHASE I AWARD ABSTRACTS

ARMY PROJECTS

VOLUME I

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PREFACE

This report presents the technical abstracts of the Phase I proposals that resulted in contract awards during Fiscal Year 1993 from solicitations of the Department of Defense (DoD) Small Business Innovation Research (SBIR) Program. The Army, Navy, Air Force, Advanced Research Projects Agency (DARPA), Defense Nuclear Agency (DNA), Ballistic Missile Defense Organization (BMDO, formerly SDIO), and Special Operations Command (SOCOM) are the DoD components of the SBIR Program. Two solicitations inviting small business firms to submit proposals under this program were published in FY93. Army, Navy, Air Force, ARPA, DNA, and BMDO participated in Program Solicitation 93.1 (Closing Date: 15 January 1993), and Army, Navy, ARPA and SOCOM participated in Program Solicitation 93.2 (Closing Date: 2 August 1993). The selection of proposals for funding was made from proposals received by the Military Services and Agencies.

FY 1993 SBIR PROGRAM

	Number of Topics		Proposals Received		Phase I Awards			
	93.1	93.2	93.1	93.2	91	92	93.1	93.2
Army	36	309	498	2,840	--	246	42	--
Navy	132	145	1,624	1,102	20	84	187	9
Air Force	188	--	2,996	--	--	4	466	--
ARPA	32	87	407	817	--	--	58	--
DNA	20	--	190	--	--	--	19	--
BMDO	16	--	767	--	--	--	147	--
SOCOM	--	3	--	37	--	--	--	3
Total	424	544	6,482	4,796	20	334	919	12
Grand Total	968		11,278		1,285			

As of the FY93 Annual Report (dated 15 March 1994), most of the FY93.2 proposals were selected but not yet awarded. The figures above show a quarter of the Phase I awards made in FY93 came from the FY91 and FY92 solicitations. Of the 1,285 Phase I awards made in FY93, 258 awards (approximately 20 percent) went to minority-owned or woman-owned businesses.

In order to make information available on the technical content of the Phase I projects supported by the DoD SBIR Program, four volumes containing the abstracts and contracts for the awarded projects are published. The small business information with accompanying abstract are arranged in alphabetical order by firm name. Cross reference indices appear at the back of the volume for quick reference.

- Volume I contains Army Projects
- Volume II contains Navy Projects
- Volume III contains Air Force Projects
- Volume IV contains ARPA, DNA, BMDO, and SOCOM Projects

Venture capital and large industrial firms that may have an interest in the research described in the abstracts in this publication are encouraged to contact the firm whose name and address is shown.

(5) (6B)

INTRODUCTION

In 1982, Congress enacted and the President signed the "Small Business Innovation Development Act of 1982" (Public Law 97-219), which created the Small Business Innovation Research (SBIR) Program to give small, high-technology firms a greater share of the federally-funded research and development contract awards.

Under the SBIR Program, each federal agency with an extramural budget for research or research and development in excess of $100 million per fiscal year must establish an SBIR Program. The program is currently funded by setting aside 1.5 percent of the participating agency's extramural R&R&D contracting dollars. The agencies participating in the Department of Defense SBIR Program are the Army, Navy, Air Force, Advanced Research Projects Agency (ARPA), Defense Nuclear Agency (DNA), Ballistic Missile Defense Organization (BMDO, formerly SDIO), and Special Operations Command (SOCOM).

The objectives of the DoD SBIR Program include stimulating technological innovation in the private sector, strengthening the role of small business in meeting DoD research and development needs, encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD-supported research or research and development.

The SBIR Program consists of three distinct phases. Under Phase I, DoD components make awards to small businesses, typically of up to one man-year of effort over a period of six months, subject to negotiation. Phase I is to determine, insofar as possible, the scientific or technical merit and feasibility of ideas or concepts submitted in response to SBIR topics. Proposals selected for contract award are those which contain an approach or idea that holds promise to provide an answer to the specific problem addressed in the topic. Successful completion of Phase I is a pre-requisite for further DoD support in Phase II.

Phase II awards will be made only to firms on the basis of results from the Phase I effort, and the scientific and technical merit of the Phase II proposal. Proposals which identify a follow-on Phase III funding commitment will be given special consideration. Phase II awards will typically cover two to five man-years of effort over a period of 24 months, also subject to negotiation. The number of Phase II awards will depend upon the success rate of the Phase I effort and availability of funds. Phase II is the principal research or research and development effort, and requires a comprehensive proposal outlining the intended effort in detail.

In Phase III, an innovation is brought to the marketplace by private sector investment and support. No SBIR funds may be used in Phase III. Also, under Phase III, DoD may award follow-on contracts with non-SBIR funds for products and processes meeting DoD mission needs.

Proposals received in response to a DoD solicitation are evaluated on a competitive basis in the organization which generated the topic, by scientists and engineers knowledgeable in that area. Selections for Phase I are made in accordance with the following criteria:

- The soundness and technical merit of the proposed approach and its incremental progress toward topic or subtopic solution.
- The potential for commercial (government or private sector) application and the benefits expected to accrue from this commercialization.
- The adequacy of the proposed effort for the fulfillment of requirements of the research topic.
- The qualifications of the proposed principal/key investigators, supporting staff and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.

The "Small Business Innovation Act of 1986" (P.L.97-443) extended the "Sunset Clause" to 1993 and increased the taxation of the extramural research and development budget to 1.25 percent. The latest SBIR re-authorization law (P.L. 102-564), signed October 28, 1992, extends the program through 2000, doubles the taxation to 2.5 percent by 1997, and increases the average Phase I and Phase II award agreements.

4D VIDEO
3136 PAULINE DRIVE
SEBASTOPOL, CA 95472
Phone: (707) 829-8883

Topic#: 92-018 ID#: 92AVS-098
Office: AVSCOM
Contract #: NAS2-13364
PI: James S. Walton, Ph.D.

Title: An Investigation of the Feasibility of Using Video-Based Motion Measurement for Recovering Helicopter Blade Kinematics
Abstract: Traditionally, kinematic measurements have been made using electro-mechanical transducers which produce a signal which is proportional to the parameter being measured. This approach is unlikely to be replaced by optical tracking techniques, but there are many instances where it is impractical (or even impossible) to attach a mechanical device to the subject. The blades of a helicopter rotor are an excellent case-in-point. While a better understanding of blade kinematics is fundamental to the design of the aircraft, it is difficult to recover three-dimensional kinematics by traditional means under operational conditions. 4D Video believes that an image-based motion measurement system can be used to quantify the rigid-body dynamics of helicopter rotor blades under operational conditions. We propose to investigate the most appropriate means for achieving this objective. Our purpose is to develop a specification which will form the foundation of an SBIR Phase II proposal to develop new hardware and software to perform the required tasks. For the purpose of the present proposal, our effort will focus on two issues: sample-rate, and the development of a customized (circular) tracking algorithm which will take maximum advantage of the predominant motions of the rotor blades. However, other issues have been identified and will be addressed.

ABTECH CORP.
700 HARRIS STREET
CHARLOTTESVILLE, VA 22903
Phone: (804) 977-0686

Topic#: 92-022 ID#: 92AVS-143
Office: AVSCOM
Contract #: DAAJ02-93-C-0006
PI: Gerard J. Montgomery

Title: Expert Polynomial Network Turbine Engine Diagnostician
Abstract: The objective of this effort is to demonstrate a prototype advanced diagnostic system for the T800 turboshaft engine using a hybrid polynomial network and production-rule expert system. The resulting system will demonstrate the feasibility of developing a revolutionary diagnostic capability which can model the engine at a system level, detect failures before they become significant isolate faults, estimate the loss of efficiency of various engine components, and predict future faults. AbTech has developed an innovative network approach, called polynomial networks, based on over a decade of research in neural networks and advanced statistics. Polynomial networks are simply networks of very powerful high-order polynomial equations. It discusses how networks can be applied to substantially increase the control and diagnostic capabilities of systems in a practical and very cost-effective manner. It then details a specific project to integrate and apply the existing AIM software and a production-rule system to T800 engine diagnostics.

ADROIT SYSTEMS, INC.
209 MADISON STREET
ALEXANDRIA, VA 22314
Phone: (703) 684-2900

Topic#: 92-034 ID#: 92SS -006
Office: CECOM
Contract #: DAAB07-93-C-A507
PI: Richard D. Jurgens

Title: Autonomous, Hand-held Satellite Location and Pointing System (SLAPS)
Abstract: Adroit Systems, Inc. proposes to develop a hand-held, autonomous Satellite Location and Point System (SLAPS). The system will store communication satellites' ephemeral data to calculate and display visibility windows. SLAPS also will use this data to calculate the azimuth and elevation angle to the communication satellite of interest. The system will use interferometry of Global Positioning System (GPS) satellite signals to determine its pointing angle. The user will be guided to the proper pointing angle by a visual display and audio cuing. Using GPS to determine the pointing angle to the satellite confers additional benefits on the user. The user will have his position and time in a universal reference frame used by the rest of the military. A pointing system based on GPS does not have to be calibrated, and is made of rugged, solid state electronics with no moving parts or optics. It will work in all latitudes because it is not susceptible to magnetic field deviations. In Phase I, Adroit proposes to develop the system and component functional specifications. These specifications will be used to determine the feasibility of the concept. A design methodology will then be developed in anticipation of prototyping SLAPS in Phase II.

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ADVANCED COMPUTER SUPPORT COMPANY
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LOS ANGELES, CA 90034
Phone: (310) 815-4858
Topic#: 92-038 ID#: 92C3 -032
Office: CECOM
Contract #: DAAB07-93-C-B503
PI: Dr. Anat Gafni
Title: Data Distribution Technology
Abstract: This proposal describes a system architecture that we propose to implement as a programmer's toolkit for the triggered distribution of information within a distributed object-oriented database. The system architecture permits sudden appearance and disappearance of data objects, understands that the communication infrastructure can be temporarily partitioned, and guarantees that rule firings cannot cause unstable, non-terminating sequences of updates. The architecture permits a spectrum of data consistency algorithms and database transaction models. The data object structure allows procedures within the object to be preceded by a pre-condition that can check permissions, legitimate input values and data integrity prior to execution. Post-conditions implement consistency checking, replication of objects and processes, and triggers that further activate other procedures or other objects. Triggers enable versions of objects. The toolkit consists of routines to communicate updates and register rules and triggers between databases. The architecture supports the efficiency discovery of objects that merit attention. It permits dynamic changes in the rule set, yet provides an efficient indexing mechanism to avoid evaluating triggers needlessly.

ADVANCED DEVICE TECHNOLOGY, INC.
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NASHUA, NH 03063
Phone: (603) 886-4943
Topic#: 93-014 ID#: 93MIC-116
Office: MICOM
Contract #: DAAHO1-93-C-R338
PI: Dr. Peter J. Kannam
Title: Integrated Three Color Sensor for Simultaneous Fusion
Abstract: We propose to develop a Three Color HgCdTe Focal Plane Array with Built-In Image Fusion. The innovative features are: The detection of SWIR (.7-1.5um), MWIR (3-5um) and LWIR (8-13um) signals takes place in the same pixel. (Co-Located Pixel) Advanced CMOS readout circuitry is incorporated in the focal plane array to perform the signal processing of the three waveband signals in a simultaneous fashion. The design readily gives the capability for Image Fusion of the three colors. Multiple layers of HgCdTe material growth by OMVPE method is described. Detailed fabrication steps to achieve pixel co-location are shown. Advanced MUX design for triple band focal plane array is described. The proposed method is such that the cross talks between the three wavebands and the adjacent diodes are completely eliminated. During Phase I, preliminary experiments will be conducted to grow three color HgCdTe films. The fabrication method to achieve co-located array will be eliminated. During Phase II, 128x128 Element Staring Array with readout circuit will be fabricated and tested.

ADVANCED FUEL RESEARCH, INC.
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EAST HARTFORD, CT 06138
Phone: (203) 528-9806
Topic#: 93-028 ID#: 93MTL-013
Office: MTL
Contract #: DAAL01-93-C-4058
PI: Dr. Stuart Farquharson
Title: Detection of Environmental Deterioration in Fiber-Reinforced Composites by FT-Raman Spectroscopy
Abstract: A number of advanced fiber-reinforced organic matrix composites employed in a variety of Army systems are exposed to environmental weathering and/or in-service loading. This may induce chemical, physical, and mechanical changes in the composite material, and ultimately lead to component failure. This proposal will develop a fiber optic based Fourier transform Raman (FT-Raman) spectrometer for the nondestructive evaluation of composite material deterioration due to environmental weathering. This proposal will focus on the effect of photo induced oxidation occurring at the surface as a function of temperature and moisture. A series of composites employing graphite, fiberglass and Kevlar as reinforcement fibers in epoxy and polyamide matrices will be subjected to accelerated environmental deterioration. The FT-Raman system will correlate environmentally induced changes in Raman spectral features to changes in mechanical properties. These measurements will be used to quantify the degree of environmental durability of the various composites. During Phase II, this information will be used to develop a methodology to assess and predict in-use component performance. Also, during this phase a field-portable prototype will be developed which includes an extended fiber optic probe with the potential of assessing a full-scale composite structure employed in an Army system.

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ADVANCED MATERIALS CORP.
100 N. BELLEFIELD AVENUE, SUITE 861
PITTSBURGH, PA 15213
Phone: (412) 268-3469
Topic#: 92-035 ID#: 92NV -072
Office: CECOM
Contract #: DAAB07-93-C-U005
PI: L.J. Denes
Title: Non-cooperative Combat Identification Using Multispectral Imaging
Abstract: We propose development of a 'smart' optical preprocessor that installs as an integral part of the light gathering optics of first- or second-generation forward looking infrared imaging systems (FLIRs). This optical preprocessor is based on an advanced-art imaging acousto-optic tunable filter (aka, A-O filter). These newly-configured A-O filters are programmable to seek out specific spectral features of any potential target, at video rates, with through puts approaching 100%, and with diffraction-limited clarity. One device can be made to operate from the UV to the mid IR. This versatility far surpasses any other spectral imaging approach. Every object has (or can be given in painting) a unique IR optical signature. In our concept, emblems or 'flags' are painted on friendly targets giving unique IR signatures but still camouflaged in the visible spectrum. These paints are modified formulations of camouflage coatings. Two example approaches are deuterated-modified and IR laser dye-modified polyurethane camouflage paints. Deuterated-modification shifts the IR absorption bands around 3.4 um while IR laser dyes will provide intense absorption lines in the near IR 90.7-1.1 um). Non-friendly targets, of course, can also be directly acquired and identified using the same optical preprocessor hardware. Once their IR spectral signatures are known, camouflaged targets used by foes can be isolated from background clutter. In other missions, objects such as vegetation types (i.e. coca plants) or vapor cloud hazards (e.g., chemical, biological or carcinogenic) can also be identified through their optical signature.

ADVANCED MECHANICAL TECHNOLOGY, INC.
151 CALIFORNIA STREET
NEWTON, MA 02158
Phone: (617) 964-2042
Topic#: 92-070 ID#: 92NAT-086
Office: NATICK
Contract #: DAAK60-93-C-0035
PI: Andrew D. Vasilakis
Title: Diesel-fired Self-pumping Water Heater R&D
Abstract: A self-pumping water heater is proposed wherein a small portion of the water to be pumped is evaporated in a boiler and used to pressurize and heat the main stream of water. Unlike early slow direct-acting steam pumps, the proposed approach operates at moderate frequencies and is extremely compact. In Phase I, an analytical model describing the dynamics of the process would be formulated, and a proof-of-principle self-pumping water heater would be fabricated and tested.

ADVANCED ROTORCRAFT TECHNOLOGY, INC.
1685 PLYMOUTH STREET, SUITE 250
MOUNTAIN VIEW, CA 94043
Phone: (415) 968-1464
Topic#: 93-004 ID#: 93AVS-023
Office: AVSCOM
Contract #: NAS2-13914
PI: Yoon Jung
Title: Modeling Complex Automatic Flight Controls for Helicopter Systems
Abstract: The Second Generation Helicopter Analysis System (2GCHAS) has been developed to provide a common framework for interdisciplinary design and analysis of rotorcraft systems. A current limitation is the level of sophistication available in modeling advanced control systems. Advanced Rotorcraft Technology will utilize the Phase I effort to carefully define the specifications, develop the algorithms, and implement the softwares in the 2GCHAS for the following: 1) Development of control element library of both linear and nonlinear control elements such as transfer function, limiters, deadbands, switches, time delay, etc. 2) Development of algorithm of computation of nonstructural state outputs such as vehicle attitudes, altitude, airspeed, for output feedback control. 3) Modification of assembly and solution algorithm for both decoupled and fully coupled analysis. 4) Implementation of control system analysis utilities such as Nonparametric Identification, Moving Block Average Fast Fourier Transforms, Riccati Equation Solutions, and Loop Transfer Recovery, and H-infinity methods. 5) Development of a graphical user interface prototype. A test method will be devised to test an advanced output feedback control system.

ADVANCED SCIENTIFIC CONCEPTS, INC.
2020 ALAMEDA PADRE SERRA, SUITE 123
SANTA BARBARA, CA 93103
Phone: (805) 966-3331
Topic#: 92-154 ID#: 92ARI-022
Office: ARI
Contract #: MDA903-93-C-0109
PI: James Geiwitz, Ph.D.
Title: Assessment and Training of Metacognitive Skills

Abstract: Metacognitive skills that involve the monitoring and control of cognitive skills like problem solving develop in expert executives and appear to lead to great improvement in the problem solving process. We propose to study the topic of metacognition to construct a conceptual model that has three characteristics: 1) it will show the interrelationship of metacognitive skills and cognitive task performance so that 2) it will suggest the most valid assessment technique for the measurement of metacognitive skills and 3) it will show the development of metacognitive skills. From the third characteristic, we will design a training program to accelerate the acquisition of metacognitive skills in officers in the US Armed Forces. From the second characteristic, we will construct proficiency tests of metacognitive skills for measuring the level of these skills in commanders at various levels of professional development; the tests can also be used to evaluate the effectiveness of the training.

ADVANCED SYSTEM TECHNOLOGIES, INC.
12200 E. BRIARWOOD AVENUE, SUITE 260
ENGLEWOOD, CO 80112
Phone: (303) 790-4242

Topic#: 92-032 ID#: 92AV-031
Office: CECOM
Contract #: NAS1-20036
PI: Dr. Robert T. Goettge

Title: Automated Design Tool Set for Reliability and Performance Evaluation of Fault-Tolerant Avionics Systems

Abstract: Reliability and performance are critical characteristics of the Army's avionics systems. These systems must meet stringent requirements in the areas of: (1) dispatchability, or operational readiness to support missions; (2) dependability, or the ability to perform critical functions correctly during the duration of the mission; and (3) responsiveness, or the ability to deliver computing services at rates sufficient to meet time-critical processing deadlines. Automated tools are needed to evaluate the implications of complex design alternatives in these areas of system effectiveness. Phase I research will determine the feasibility of an automated tool set for integrated evaluation of fault-tolerant avionics system reliability and performance. The tool set will consist of separate design capture, design translation, and design evaluation capabilities. Quantitative measures of effectiveness that will be produced by the tool set include system maintainability and availability, probability of avionics system failure during missions of given duration, and critical function response times and resource utilizations. Capabilities provided by existing automated tools, including the START tool for integrated reliability and performance analysis, as well as other reliability prediction tools such as HARP, SHARPE, and ARAM, will provide a starting point for the tool set specification to be developed in Phase I.

ADVANCED TECHNOLOGY AND RESEARCH CO
14900 SWEITZER LANE, SUITE 104
LAUREL, MD 20707
Phone: (301) 498-8200

Topic#: 92-060 ID#: 92MIC-018
Office: MICOM
Contract #: DAAHO1-93-C-R138
PI: Randy R. Kindsfather

Title: Day/Night Low Light Level (LLL) TV Sensors

Abstract: A low-cost, miniaturized Low Light Level (LLL) CCD TV camera system capable of more than 400 TV lines per picture height at an illumination level ranging from moonless starlight (10 E-4 foot candles) is proposed. The electro-optical portion of the system will incorporate an input lens with an electrically controllable iris, a GEN III image intensifier, a coupling lens and a 2/3-inch CCD. With careful design and component selection, a signal-to-noise ration of 9 or better can be achieved at low light level conditions while maintaining daylight operability. Digital techniques will be employed both to optimize image exposure and to reduce noise. Iris diameter, intensifier gain and shutter duration will be set through multi-zone metering and fuzzy logic control. Fixed pattern noise will be filtered by temporal averaging and edge-preserving spatial smoothing techniques. Multi-zone metering and all noise filtering algorithms will be implemented in hardware for video rate output. Performance of the final electro-optical design will be verified through a detailed math model, and that of exposure control and noise filtering will be verified through extensive computer simulation.

ADVANCED TECHNOLOGY MATERIALS, INC.
7 COMMERCE DRIVE
DANBURY, CT 06810
Phone: (203) 794-1100

Topic#: 92-044 ID#: 92NV-037
Office: CECOM
Contract #: DAAB07-93-C-U003
PI: David Kurtz

Title: Thermally Isolated PbTiO3 Uncooled Focal Plane Array Detector

Abstract: Infrared sensors and sensor arrays are widely used in military and commercial applications such as night vision, medical diagnosis and weather mapping. Expensive quantum effect sensors, such as HgCdTe systems, must be cooled to liquid

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nitrogen temperatures and are difficult to produce with uniform properties. A significant opportunity exists to dramatically improve detector fabrication and performance by employing thin film pyroelectric materials for the detector element. While encouraging pyroelectric properties have been reported in several ferroelectric materials, PbTiO3 is advantageous because of its high pyroelectric coefficient (40-90 nC/cm2.K at 297K), high Curie temperature (490 degrees C), mechanical and chemical resistance. PbTiO3 can be deposited in thin film form. However, unless thermal mass is minimized, pyroelectric sensitivity is severely reduced. ATM proposes to develop a thermally isolated micro air-bridge device using a novel MOCVD technique for PbTiO3 growth that will not only produce high pyroelectric sensitivity material, but also lead itself to c-axis oriented, high density array fabrication on a manufacturing scale with significantly reduced Pb toxicity hazards. The Phase II program will address fabrication and integration of high density detector arrays on silicon substrates containing CMOS circuitry.

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DANBURY, CT 06810
Phone: (203) 794-1100
Topic#: 92-131 ID#: 92MTL-169
Office: MTL
Contract #: DAAL01-93-C-4006
PI: Delwyn Cummings
Title: Improved Tungsten Penetrators
Abstract: Kinetic energy penetrators are currently relied upon as a way to defeat enemy armor. Historically these penetrators have been composed of uranium or tungsten based alloys due to their high densities. In addition to density, the deformation behavior of the alloy determines it's performance. A penetrator whose tip mushrooms or fractures on impact is less effective than a penetrator that retains it's shape or has a tip that self sharpens. Although the densities of uranium and tungsten are similar, uranium alloys have generally exhibited deformation on impact that has resulted in better penetrator performance. The drawback with uranium alloys, however, is toxicity and cost. In this Phase I SBIR program, tungsten alloys will be processed in a variety of novel ways to improve their performance as penetrators. ATM proposes to produce large (>10 mm diameter) [100] oriented crystals of pure tungsten and W-Ni-Fe alloy rods with elongated and preferred orientation of the grains. The effect of rhenium additions will also be examined. X-ray diffraction, high rate compression testing, and optical microscopy will be used to assess the results.

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Phone: (407) 984-1671
Topic#: 92-172 ID#: 92SDC-026
Office: SDC
Contract #: DASG60-93-C-0006
PI: Steve Iezzi
Title: A Multi-processor Embedded Data Processor for Multi-Object Detection & Tracking
Abstract: The Aeronix Phase I task will demonstrate the application of an innovative parallel processing computer architecture and parallel processing programming environment to a class of problems associated with the real time detection, recognition, acquisition and tracking of multiple objects in a high rate image sensor environment. The Phase I task will examine the problems associated with the multiplicity of objects in a large image data space and present a comprehensive process for the collection filtering, transformation and analysis of these objects across multiple processing elements. The Phase I task will map the Kinetic Energy Anti-Satellite Program requirements on the Aeronix proprietary Embedded Data Processor (EDP) Architecture. The EDP is a space based Multi Instruction Multi Data Stream (MIMD) parallel processing architecture for embedded data processing applications. The EDP offers significant increases in performance (up to 1000's of HIPS) over conventional architectures while improving overall system reliability and providing inherently high levels of fault tolerance.

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Topic#: 92-051 ID#: 92MIC-021
Office: MICOM
Contract #: DAAHO1-93-C-R094
PI: Gerald J. Wotel
Title: Tactical Missile Air Turbo Rocket Propulsion System Critical Components Definition Study
Abstract: The air turbo rocket (ATR) offers significant potential in terms of cost/performance ratio for tactical missiles. The high specific impulse of the ATR significantly increases range over solid rockets, while maintaining critical missile weight and launch system geometry constraints. The higher thrust levels of the ATR improve acceleration capability and rapid thrust control over a similar size turbojet. The program has two major tasks. Task 1 will develop an ATR cycle computer code, and be

executable on an IBM PC or compatible microcomputer. The cycle code will then be utilized to develop an ATR conceptual design. Rocket propellants will be evaluated and used in a mission analysis. The cycle code will be integrated into a two-dimensional trajectory simulation code. A parametric mission analysis will be conducted, varying ATR propulsion design parameters, and propulsion system size. Cycle parameters critical to achieving the mission goals will be identified. A design will be selected and mission performance variations determined for alternative propellants. An optimum design will then be selected and recommended. Task 2 encompasses the detailed design of the flight weight ATR propulsion system. A heavyweight test component will be designed and fabricated.

AKM ASSOC., INC.
635 MARINER'S ISLAND BIVD., SUITE 205
SAN MATEO, CA 94404
Phone: (415) 571-7910
Topic#: 92-090 ID#: 92TAC-149
Office: TACOM
Contract #: DAAE07-93-C-R032
PI: Dr. Asok K. Mukhopadhyay
Title: Integrated Two-man Crew Station (ITCS) AI Application Study
Abstract: Tank Automotive Command (TACOM) of the U.S. Army has embarked on a major program called VETRONICS (Vehicle Electronics). VETRONICS envisions the application of state-of-the-art electronics systems in the form of an architecture that will integrate all the vehicle electronics and electrical systems including those directly related to combat, communications/command/control/intelligence(C3 I) and survivability functions. This system will enable future vehicles to utilize all the available information that results from the application of electronics technology on tomorrow's battlefield. An integral part of the VETRONICS program is the Integrated Two-man crew station (ITCS). Normally a combat vehicle (i.e., battle tank) carries four crew members commander, driver, gunner and loader. When the crew size is reduced to two, the commander and the gunner, many tasks will be forced to be autonomous or semi-autonomous not to overload the two-man crew. ITCS will go a long way to prove the field ability of a two-man crew in a combat vehicle. The proposed Phase I effort will consist of an in-depth study of Artificial Intelligence (AI) techniques and their possible applications that would be necessary for development of ITCS. Tradeoff studies of existing hardware and software will be conducted. The effort will also consist of identification of other features to enhance future combat vehicles using AI. The Phase II effort will consist of determining the two most critical AI functions for development of the ITCS and developing the needed hardware and software for those functions for integration into the ITCS.

AMERICAN GNC CORP.
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CHATSWORTH, CA 91311
Phone: (818) 407-0092
Topic#: 92-013 ID#: 92AVS-074
Office: AVSCOM
Contract #: DAAJ02-93-C-0012
PI: Ching-Fang Lin
Title: Rotorcraft-specific Reconfigurable Flight Control System
Abstract: Advanced rotorcraft systems are highly complicated and have become prime targets for enemy anti-air weapons. Thus, battle-induced damage can be anticipated. To increase the availability, combat survivability, maintainability, and life-cycle cost effectiveness of advanced rotorcraft, reconfigurable flight controls are needed. In this project, a rotorcraft-specific reconfigurable flight control system is developed. This system addresses unique characteristics of the rotorcraft system which is not surface-rich in comparison to its fixed-wing counterpart. The fuzzy logics are used to furnish in-flight fault detection, on-board expert diagnosis evaluation, and real-time fault accommodation functions. A two layer arrangement of fuzzy logics are also used for mode blending to enhance pilot handling qualities. Simulations are used to verify and quantify the performance of the fuzzy reconfigurable flight control system. In Phase II, the design, both software and hardware, will be implemented and tested in a hardware-in-the-loop environment.

AMERICAN RESEARCH CORP. OF VIRGINIA
P.O. BOX 3406
RADFORD, VA 24143
Phone: (703) 731-0655
Topic#: 93-022 ID#: 93STR-005
Office: STRICOM
Contract #: M67004-93-C-0082
PI: Mr. John A. Neal, III
Title: Icon-based Intelligent Tutoring System Utilizing Fuzzy Expert Systems and Multi-media Gaming Simulations
Abstract: The Army has identified a need for software which supports intelligent tutoring requirements. To address this need, American Research Corporation of Virginia proposed the innovative application of fuzzy expert systems, multi-media

presentation, and high resolution graphics in a diagrammatic (iconic) environment as an Intelligent Tutoring System capable of analyzing user performance and interest parameters and providing gaming simulations which support user learning goals. The proposed innovation is an expert system architecture containing fuzzy logic sub-modules interacting with multi-media sources to generate gaming simulations. Program objectives include design of learning methodologies and supporting instructional strategies and gaming simulations, design of an interactive iconic user interface based on high resolution computer graphics and multi-media presentation techniques, development of expert system control and analysis paradigms, and testing and verification of the Phase I system. The proposed effort will demonstrate a proof-of-concept system which utilizes fuzzy expert system analysis and control techniques and multi-media presentation techniques for application to intelligent tutoring and associated gaming simulations. The results anticipated include development of a fuzzy expert system architecture and graphical user interface which is flexible enough to be used in a variety of complex tutoring and gaming applications.

AMERICAN RESEARCH CORP. OF VIRGINIA
PO BOX 3406
RADFORD, VA 24143
Phone: (703) 731-0655

Topic#: 92-099 ID#: 92ARO-008
Office: ARO
Contract #: DAAH04-93-C-0010
PI: Dr. Adel K. Sarrafzadeh

Title: Digital Speckle Imaging for In-situ Monitoring and Characterization of Laser-processed Refractory Coatings

Abstract: The use of high-temperature laser densification/annealing techniques for enhancing materials surface characteristics has opened new opportunities in material/laser-process diagnostic instrumentation. Important issues in fabrication of reproducible refractory ceramic coating film lies in understanding of the interrelationship between processing parameters and surface properties. To respond to this need, the proposed project involves the development of diagnostic instrumentation based on laser speckle imaging for in-situ process monitoring and quantitative characterization of high-temperature structural ceramic coating properties. The program is innovative in correlating process parameters relating to coating-sensitive properties at temperatures exceeding 1500 degrees C. Variations in surface-reflected optical images in terms of speckle spatial frequencies and correlation intensities, due to different glass phase transformations, will identify characteristic signatures associated with film formation. Phase I technical objectives include the analysis of randomly scattered laser speckle characteristics for optically rough surface coatings, evaluation of laser speckle imaging techniques for measurement of micro-surface properties, assessment of empirical correlation on experimental parameters and optimization of a proof-of-concept instrumentation for in-situ monitoring of laser-processed refractory ceramic coating films.

AMHERST SYSTEMS, INC.
30 WILSON ROAD
BUFFALO, NY 14221
Phone: (716) 631-0610

Topic#: 93-006 ID#: 93BRD-007
Office: BRDEC
Contract #: DAAK70-93-C-0060
PI: Robert H. Giza

Title: Coating Design and Evaluation Model

Abstract: The development of paints and coatings is characterized by trial and error formulation of various pigment and binder combinations. A need exist for an analytical tool which permits the controlled variation of fundamental coating properties and prediction of the resulting reflectance. Amherst Systems proposes to provide such a tool based upon the government-owned Coatings Reflectance Engineering and Evaluation Program (CREEP). The proposed effort shall extend the current CREEP capabilities while providing an improved user interface for the specification of coating parameters and interpretation of predicted results.

ANALATOM, INC.
1183 BORDEAUX DRIVE #1
SUNNYVALE, CA 94089
Phone: (408) 734-9392

Topic#: 92-064 ID#: 92MIC-132
Office: MICOM
Contract #: DAAHO1-93-C-R157
PI: J. Altman, Ph.D.

Title: Organically Modified Silicates as a Solid Host for Organic Laser Dyes

Abstract: The proposed Phase I work will constitute a study of prospective organic dye host materials, fabrication techniques, AR/HR/PR (Anti-Reflection/High Reflection/Partial Reflection) optical coatings (specific to the selected host material), and factors which are relevant to optical pumping with flash lamps or equivalent sources. Special emphasis will be placed upon organically modified silicates (ORMOSILs). Because of our current expertise in the field we believe Analatom occupies a

(15)

leadership position in the development of ORMOSILs for solid state dye lasers, we are especially well qualified to pursue this line of research/development at the present time. The principal investigator for this project has been intimately involved in solid state dye laser development for the past two years. Our goal for the proposed work will be to extend the present dye lifetimes in a solid state ORMOSIL, or other as yet unidentified host, by an order of magnitude or more over current lifetimes while maximizing optical conversion efficiency. We have evidence to indicate that the stated goals are very realistic ones and should be readily achieved during the course of the contract.

ANALYTIC DESIGNS, INC.
245 EAST GAY STREET
COLUMBUS, OH 43215
Phone: (614) 224-9078
Topic#: 92-006 ID#: 92AVS-005
Office: AVSCOM
Contract #: DAAJ02-93-C-0009
PI: Dr. Harry Shamansky
Title: LO Rotor Blade De-Ice Systems Evaluation
Abstract: This proposal investigates candidate main rotor blade de-icing systems which offer signature reduction capabilities. In comparison to traditional mechanical boot style de-icing systems, electrical de-icing systems are considered. One such candidate is a novel electrical thin film resistive de-icing system, which shows potential to lower the RCS levels associated with main rotor blade systems. This de-icing approach is a modified form of resistive heating. The resistive element is comprised of a thin sheet of resistive material in the areas of ice accretion on the rotor blade surfaces. In contrast to traditional resistive heating where highly conductive wires are used, a film of resistive materi i can be used to achieve the desired low observable (LO) specifications. This approach would be applicable as both an ice prevention technique and a de-icing technique. Basic evaluation of this approach will be performed through numerical and experimental investigation. Comparisons will be made to the traditional mechanical and electrical de-icing systems with various signature reduction techniques to assess the viability of the thin film resistive de-icing system.

ANALYTIC DESIGNS, INC.
245 EAST GAY STREET
COLUMBUS, OH 43215
Phone: (614) 224-9078
Topic#: 92-139 ID#: 92VAL-005
Office: VAL
Contract #: DAAL01-93-C-2005
PI: Dr. Nan Wang
Title: Bi-Static Chaff Signature Modeling
Abstract: The scattering behavior for a collection of thousands of linear dipoles at resonance has long been a subject of study for passive electronic countermeasures (ECM) against pertinent threat radar systems. Previously, the echo area of the radar cross section (RCS) of a chaff cloud has been calculated by multiplying the number of dipoles by the so-called "tumble average RCS" of a single dipole. Estimates based on this simple model have been poor. In this study a rigorous mathematical model based on the sinusoidal reaction formulation will be solved by the method of moments of the Galerkin type. Using a snap-shot model of various chaff geometries, possibly from a fractal based generator, both the mono-static and bi-static scattering signatures will be statistically characterized. Furthermore, the effects of aspect angle on chaff signatures will be quantified, and the correlation between the chaff signatures obtained at different look angles will be established.

ANALYTICAL DESIGNS, INC.
194 N. SUNNYVALE AVE.
SUNNYVALE, CA 94086
Phone: (408) 732-2927
Topic#: 92-007 ID#: 92AVS-013
Office: AVSCOM
Contract #: NAS1-19982
PI: Brian Howley
Title: Control System for Model Scale Semi-autonomous Rotorcraft Research Vehicle
Abstract: The purpose of this study is to explore and develop the best candidate attitude control system to maximize the FFRRV flight envelope and handling qualities for various rotorcraft configurations. The intent is to provide a controls design methodology which allows hardware and software reconfigurations and leverages the ease and simplicity of down loading design parameters to a well defined and robust adaptive control system. An automated controls design will be computer implemented and used to determine the appropriate gains and filters given the FFRRV configuration. This will then be down loaded as machine code using a commercially available auto-code generator to a flight processor commanding a defined architecture of multiple control loops i.e. torque, rate, attitude and velocity loops. Off the shelf commercial grade hardware for inertial instruments, transmitters/receivers, and electric servos/controller will be compiled and evaluated for modularity and

maintainability. Both modern and classical control techniques will be explored.

ANALYTICAL SERVICES & MATERIALS, INC.
107 RESEARCH DRIVE
HAMPTON, VA 23666
Phone: (804) 865-7093
Topic#: 92-082 ID#: 92TAC-053
Office: TACOM
Contract #: DAAE07-93-C-R021
PI: Charles L. Blackburn
Title: Refined Reduced Order Models for Estimation of Terrain Induced Loads in Flexible Vehicles
Abstract: The new aerospace materials are finding applications in the design of military armor vehicles. However, the effect on ride quality, fire control, and internal structural loads due to the increased flexibility of these new vehicles must be ascertained by dynamic analysis. The size of models required to simulate the flexible body effect can be prohibitive from both cost and time perspective. Therefore, this proposal is directed to the development of a technique for obtaining a refined reduced order model that can accurately predict the response of a vehicle over a frequency range of concern and lends itself to application during the design and structural optimization phase.

ANAMET LABORATORIES, INC.
3400 INVESTMENT BLVD.
HAYWARD, CA 94545
Phone: (510) 887-8811
Topic#: 92-001 ID#: 92ARD-059
Office: ARDEC
Contract #: DAAA21-93-C-0011
PI: Rocky Richard Arnold, PH.
Title: Frangible Ammunition Containers
Abstract: The objective of this Phase I work is to develop and demonstrate that a frangible munitions container, one capable of passing an Insensitive Munitions (IM) cook-off test, can be presumed with a low-cost modification to the container can. The critical problem associated with existing containers is the rapid development of combustion gases and high pressures which cause the container to literally explode creating fragments which, in turn, promulgate the fire and create ancillary explosions. The design goal is thus to provide a modification to the can that will allow venting of the combustion gases without the creation of fragment. The innovative solution provided herein relies upon the use of fracture mechanics theory and analysis to define the geometry of a crack starter machined into the surface of the can. It is informative to note that within the time period that the pressure in the container rises to critical levels (approximately 10 milliseconds), a properly configured crack starter can cause the generation of over 31 feet of crack surface. This significant level of crack formation allows for more than sufficient venting to prevent explosion and fragment formation. The key element of the innovative approach relies upon the use of state-of-the-art fracture mechanics technology and stress analyses to define the precise dimensions of the crack starter. Also, since the number of potential crack starter geometries is virtually unlimited, it is necessary in this research, to define the configuration most efficient and reliable. It is noted that this approach, once demonstrated, provides an extremely low-cost and reliable solution to the problem of venting. Phase I work will develop and demonstrate the feasibility of the innovative approach providing the Army with a highly effective system with concomitant low risk.

APPLIED POLYMER SYSTEMS, INC.
4302 E. 10TH AVE., #404
TAMPA, FL 33605
Phone: (813) 247-3065
Topic#: 92-068 ID#: 92NAT-055
Office: NATICK
Contract #: DAAK60-93-C-0019
PI: William W. Bristowe, Ph.D
Title: Development of Flexible EMI Shielded Materials
Abstract: A novel plasma spray process allows for a highly metallic filled thermoplastic to be deposited on assorted cloth substrates, to create a flexible EMI construction material. Filler causing the EMI property to occur is dry-mixed into the thermoplastic, and the coating composition is created in-situ on the cloth surface. Highly filled coatings are achievable, which previously have been denied due to rheological restrictions of using a high solids blend. Metallic fillers are proposed as the EMI shielding agent. Flexible, weather resistant thermoplastics are used as the bonding matrix for these active fillers. Excellent adhesion to the substrate is attained during the plasma process due to chemical grafting, which is caused by the plasma exposure. Cloth can be from any origin, although a synthetic fiber composition such as nylon, polyester, Nomex, or fluorinated polymer, would be preferred.

APPLIED RESEARCH ASSOC.
330 WEST 42 STREET
NEW YORK, NY 10036
Phone: (617) 862-7020
Topic#: 92-033 ID#: 92EW-043
Office: CECOM
Contract #: DAAB07-93-C-U257
PI: William J. Crosby
Title: Impulse Radar Electronic Support Measures (ESM) Techniques
Abstract: An innovative ESM impulse detection and processing concept is described, incorporating three individual, but complementary, wideband processors used in selected combinations to provide a versatile and cost effective design which can be scaled to the anticipated battlefield or civilian environment. A program is proposed to determine performance and implementation of the individual processors and the combinations in which they are best employed as a function of various impulse environments.

APPLIED TECHNOLOGY ASSOC., INC.
1900 RANDOLPH ROAD SE
ALBUQUERQUE, NM 87106
Phone: (505) 247-8371
Topic#: 92-170 ID#: 92SDC-009
Office: SDC
Contract #: DASG60-93-C-0002
PI: Robert Pierson
Title: High Energy Laser Wavefront Analysis
Abstract: There is a need for a reliable High Energy Laser Wavefront Analyzer (HELWA) to be used for beam quality testing at the Army's High Energy Laser Systems Test Facility (HELSTF). Accurate HEL wavefront measurements are critical to HEL device performance evaluation. Current devices are inflexible and difficult to maintain due to size, complexity, and a dependence of high precision moving parts. This effort will investigate the feasibility of constructing a reliable integrated wavefront sensor suitable to the HEL community and adaptable to other applications. A low maintenance high reliability wavefront analyzer is attainable by integrating innovations from two areas. The first area involves the coupling of commercially available microlenslet technology with modern infrared detector arrays; the resulting compact Hartmann wavefront sensor is a sturdy and adaptable phase and intensity sampling device capable of high spatial and temporal resolution. The second area of innovation encompasses ATA's advanced wavefront reconstruction and wavefront sensor simulation algorithms. By combining these processing, visualization, and diagnostic tools with the appropriate lenslet arrays, optics, and IR cameras, ATA will seek to design a system customized to the Army HEL operation, but flexible enough to adapt to other government and commercial applications.

ATLANTIC AEROSPACE ELECTRONICS CORP.
470 TROTTEN POND ROAD
WALTHAM, MA 02154
Phone: (617) 890-4200
Topic#: 92-059 ID#: 92MIC-099
Office: MICOM
Contract #: DAAHO1-93-C-R112
PI: Tamar Peli
Title: Fractal Analysis of Multi-band IR Imagery for Target Acquisition
Abstract: It is proposed to develop and demonstrate a new signal processing approach for acquiring low contrast military targets in multi-band IR imagery. This new computationally efficient processing methodology has been shown to provide significantly better detection/discrimination results in single-band long wave FLIR imagery as well as in the acoustic, SAR and visible optics domains. Atlantic Aerospace has emerged as the technical leader in developing and applying this technology to defense-related problem areas. We believe that the same generic approach appropriately modified to reflect the structural and textural characteristics of high value targets and typical backgrounds in multi-band IR imagery, will provide significant new capability and substantial performance gains for automatic target acquisition. In this Phase I program we will utilize our previously developed morphology-based detection algorithm, that applies both size and amplitude constraints at the pixel level, to identify potential areas of interest in multi-band IR imagery. For each of the detected areas we will perform fractal analysis independently in the available spectral bands. Our analysis methods will include the evaluation of fractal and high order signatures. The potential capability of the developed measures to automatically cue an operator or a fully automated process to areas of high value targets will be demonstrated. Although the primary interest of this Phase I program is on developing fractal-based measures for the discrimination of man-made objects from natural backgrounds, we will also analyze large patches of natural background and characterize their fractal properties in each spectral band. The emphasis will be on parameterization most appropriate for scene generation.

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ATLANTIC AEROSPACE ELECTRONICS CORP.
6404 IVY LANE, SUITE 300
GREENBELT, MD 20770
Phone: (301) 982-5273
Topic#: 92-119 ID#: 92HDL-004
Office: HDL
Contract #: DAAL02-93-C-0025
PI: Victor C. Sanchez
Title: High Performance Electrically Scanned Antenna
Abstract: The objective of the proposed Phase I effort is to perform a preliminary design of an electronically scanned antenna capable of supporting a multimode radar testbed operating in MTI, ultra-high range resolution and SAR modes. The proposed baseline antenna concept consists of four major components: a two-dimensional antenna array of polarization-diverse radiating elements, a dual purpose elevation feed, an active Rotman lens azimuth feed and an azimuth beam steering network. Use of the active Rotman Lens ("Wide Instantaneous Bandwidth Active Scanned Array", proposal dtd 5 Feb '92, submitted by Atlantic Aerospace Electronics Corp. to Harry Diamond Laboratory BAA ACT Committee) and a p-i-n diode switch beam steering network ("Low Cost Conformal Electronically Scanned Array", final report dtd 20 Sept '91, prepared by Atlantic Aerospace Electronics Corp. for Harry Diamond Laboratory under contract number DAALO2-91-C-0055) has been evaluated for radar antenna applications in the referenced earlier work and will not be considered in further detail in this proposal. The polarization-diverse elements will consist of dual-input elements with an integrated MMIC switch module to select vertical, horizontal, right-hand and left-hand circular polarizations. The elements will reside in a two-dimensional array such that each vertical, or elevation, column has a dual-mode selectable feed and all columns are fed in azimuth by the output ports of the Rotman Lens. The selectable elevation feed will be designed to switch between two pattern modes: fixed cosecant-squared and monopulse. The azimuth feed distribution will be such as to achieve peak sidelobe levels of 25db below the main beam. System performance will be quantified by predictions of antenna patterns at different frequencies (5% about 16Ghz), azimuth scan angles (within + or - 45 deg.), elevation beam modes and polarization selections.

AURORA ASSOC.
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SANTA CLARA, CA 95054
Phone: (408) 748-0867
Topic#: 92-035 ID#: 92EW-048
Office: CECOM
Contract #: DAAB07-93-C-U259
PI: Dr. I.C. Chang
Title: Non-cooperative Combat Identification
Abstract: There exists a need for an effective Identification of Friend or Foe (IFF) as part of the target acquisition function in air and ground systems. The most important constraints applied to the real time IFF system include low probability of intercept, fail-safe, safe-guarded, and almost non-cooperative. The concepts of a number of proposed new IFF techniques are described. These techniques are based on the three types of sensors: FLIR, radar, and ladar. Among the three, the approaches which appear the most practical and require simple implementation are ladar-based. Several novel processing devices that are key to the IFF sensors are discussed.

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Phone: (408) 748-0867
Topic#: 92-057 ID#: 92MIC-102
Office: MICOM
Contract #: DAAHO1-93-C-R092
PI: Dr. I.C. Chang
Title: Optical Microwave Based Technology for IFF of Unmanned Aerial Vehicles (UAV)
Abstract: The program objective is to develop and demonstrate a low cost, low probability of intercept (LPI) sensor technology for IFF of Unmanned Aerial Vehicles (UAV). Conventional approach using active microwave radars suffer from low angular resolution, high clutter, problem of electronic jamming and emitter observe ability which can be used by the enemy for homing or identification purpose. A laser radar (Ladar) approach is described. The technology needed for implementing the proposed ladar IFF system include fast beam steering device, widefield narrowband filter and coherent detection techniques. New concepts of optical preprocessing devices are proposed that will significantly enhance the performance of the IFF ladar system.

AUTOMATIX, INC.
755 MIDDLESEX TURNPIKE
BILLERICA, MA 01821
Phone: (508) 667-7900
Topic#: 92-092 ID#: 92TEC-054
Office: TECOM
Contract #: DAAD09-93-C-0021
PI: Mr. Michael Wilt

Title: Automated Smoke and Obscurant Cloud Recognition Using Machine Vision
Abstract: The objective of this program is to develop advanced image processing/analysis technology for the automatic determination of smoke and obscurant cloud spatial extent and the extraction of relevant features from video images produced by multiple visible and infrared sensors viewing a cloud from different angles. The 2D information is used to quantify the dimensions, volume, centroid, and location of the cloud. Phase I tasks will mainly include: a review of previous work particularly within DoD and in related applications such as meteorology; an analysis of application requirements; an investigation and limited prototyping of required image processing/analysis approaches. This will include proposing and evaluating image segmentation schemes that can reliably identify image regions corresponding to cloud cover, approaches for region or boundary representation and description, and extraction of geometric/topological features or other 2D measures such as cloud density. The Phase I prototyping will be performed on state-of-the-art image processing/analysis workstations implemented on standard computer platforms. Videotaped images will be used for testing the prototypes and evaluating the applicability and feasibility of the proposed schemes. On the basis of the Phase I results, needs for future R&D will be identified and the Phase II will be planned.

AUTOMATIX, INC.
755 MIDDLESEX TURNPIKE
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Topic#: 92-133
Office: MTL
Contract #: DAAL01-93-C-4040
PI: Mr. Joel Katz

ID#: 92MTL-179

Title: Vision Aided Monitoring and Control System for Ceramic and Powder Metallurgy Manufacturing
Abstract: The objective of this program is to develop non-contact vision sensing and processing schemes that can be used for ceramic and powder metallurgy process monitoring and control. Proposed applications include monitoring of overall shrinkage or differential shrinkage rates during drying of slurries, monitoring dimensional changes, shrinkage and control to final dimensions during sintering, and detecting defects and inhomogeneities before sintering. Phase I tasks will mainly include: a review of previous work particularly in ceramic and powder metallurgy process monitoring and control; an analysis of application requirements including options for interfacing with an intelligent design and processing system; an investigation and limited prototyping of required vision sensing and processing approaches. This will include both prototyping of inspection and precision gauging approaches for dimensional checking and an exploratory analysis of methods for producing optimal images under ceramic processing conditions and techniques for the measurement of local in-plane surface strains. The Phase I prototyping will be performed on state-of-the-art vision systems implemented on standard computer platforms. Limited demonstrations will be performed with simulated sintering operations in room temperature. On the basis of the Phase I results, need for future R&D will be identified and the Phase II effort will be planned.

AVATAR PARTNERS
16050 KINGS CREEK ROAD
BOULDER CREEK, CA 95006
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Topic#: 92-098
Office: STRICOM
Contract #: DAAE07-93-C-R048
PI: Peter Rothman

ID#: 92TAC-221

Title: Object-oriented Virtual Reality System for Weapons System Concept Evaluation
Abstract: Distributed simulation provides a means for weapon systems to be evaluated in a highly realistic simulation environment prior to the construction of a actual vehicle. However, today's simulators require the use of physical mock-ups of the controls and displays for each of the crew stations in order for the human operators to control the simulated vehicles. These mock-ups are expensive and time consuming to produce, and difficult to reconfigure to test new concepts. Virtual reality (VR) technology has the potential to enable the construction of "virtual crew stations" allowing test and evaluation to be performed without the need for constructing expensive physical mock-ups. This Phase I proposes research and development of a concept for a low cost virtual reality system which will enable the rapid development of crew station concepts for future Army vehicles. The proposed system will be based on Avatar's Desktop Virtual Reality System and object-oriented virtual reality architecture, ObjectVision. A rapid prototype will be constructed to demonstrate the ease with which crew station concepts can be constructed and modified within the proposed virtual reality system.

BELTRAN, INC.
1133 EAST 35 STREET
BROOKLYN, NY 11210
Phone: (718) 338-3311
Topic#: 92-006 ID#: 92AVS-009
Office: AVSCOM
Contract #: DAAJ02-93-C-0011
PI: Thomas C. Kosvic
Title: "Tripping" of Supercooled Water Drops for Helicopter De-icing
Abstract: Ice accretions on helicopter rotor blades occur as a result of the impact of supercooled water particles on the surface. Supercooled water particles are in an unstable state. Means are sought to "trip" these particles into ice crystals or amorphous snow so that the particles will not adhere to the surface. Density waves (sound) and electromagnetic waves (including lasers) are to be investigated for suitability as "trip" mechanisms which reduce the icing potential. Experiments will be conducted in a microcalorimeter using super cooled water in capillary tubes. The kinetics of freezing will be studied for the various "trip" mechanisms.

BEND RESEARCH, INC.
64550 RESEARCH RD.
BEND, OR 97701
Phone: (503) 382-4100
Topic#: 92-067 ID#: 92NAT-028
Office: NATICK
Contract #: DAAK60-93-C-0016
PI: James R. Lowell
Title: Activated-Carbon Fibers With High Surface Areas
Abstract: This proposal is directed to the preparation of high-surface-area (HSA) activated-carbon fibers that are suitable for the Army's lightweight chemical-protective combat uniforms. The overall goal of the proposed program is to develop a domestic source of activated-carbon fibers having surface areas greater than 1500 m2/g. Our approach begins with a novel method of preparing polymeric precursor fibers, which is based on existing technology now being commercialized for other applications by Bend Research. The precursor fibers will then be heat-treated, carbonized, and activated using existing, proven techniques, we believe this process offers a high probability for success. Successful completion of HTE Phase I program and a subsequent Phase II should lead to domestic production of activated-carbon fibers that are technically superior to those currently available overseas and that are less expensive to produce. During a Phase II program we would collaborate with a textile manufacturer and/or carbon-fiber manufacturer to facilitate the early commercial-scale production of the improved fibers.

BENTHOS, INC.
49 EDGERTON DR.
N. FALMOUTH, MA 02556
Phone: (999) 999-9999
Topic#: 92-023 ID#: 92AVS-154
Office: AVSCOM
Contract #: DAAJ02-93-C-0007
PI: John Sewell
Title: High Power Density Piezoelectric Actuator for Helicopter Gearbox Noise Cancellation
Abstract: A requirement exists to cancel structure-borne noise from helicopter gear boxes by attacking the source of the noise with a high power density single axis actuator. A major requirement is to provide a high force capability in the high power density package and have it be applicable to a bandwidth of 1000 to 4000 Hz. Among the candidates are ceramic, ceramic composite, magnetostrictive and electroreological fluid technology. While existing systems can produce high forces, the weight and size of these systems is far too great to be useful. Benthos, a leader in the development and manufacture of piezoelectric driven devices, in cooperation with other engineering specialists in high power density actuators, proposes to develop two high force actuators using piezoelectric and magnetostrictive actuators. Each of these will be tailored to optimize their force/weight properties, and will be tested side by side to determine the optimum configuration for the application. The objective of the study is to develop a working prototype of two tested, highly reliable actuator materials in a configuration which will be as close to a working model as feasible in this first phase. From the results of the subsequent analysis, a design will be submitted for a refined version of the actuator to be built and tested in anticipation of the FSD phase of the project.

BERKELEY RESEARCH ASSOC., INC.
P.O.BOX 241
BERKELEY, CA 94701
Phone: (703) 750-3434
Topic#: 92-127 ID#: 92HDL-081
Office: HDL
Contract #: DAAL02-93-C-0028
PI: Jeffry Golden
Title: Improved Vertical Field Simulation Fidelity for the "Aurora" Gamma Ray Simulator
Abstract: Scale model testing is proposed for the development of a transmission line for applying a vertical electric field that

is synchronized to the AURORA radiation pulse to improve the SREMP simulation fidelity in the AURORA test cell. The scale model tests will permit more rapid and affordable design changes than a full scale model so that the effects of time varying air conductivity and coupling to the conducting walls of the test cell can be better studied. Novel construction techniques are also proposed which may lead to lower cost than conventional approaches for the implementation of the transmission line scheme of U.S. patent 4,393,509 by G. Merkel and W.D. Scharf (July 12, 1983). In addition, the exploratory development of a single point initiated, field distortion, oil dielectric switch is proposed as a means to reduce the asynchronism of the four AURORA diode pulses which also affects the simulation fidelity. The Phase I effort includes the preliminary design and cost determination of the full scale system to be constructed in Phase II.

BIO-IMAGING RESEARCH, INC.
425 BARCLAY BLVD.
LINCOLNSHIRE, IL 60069
Phone: (708) 634-6425
Topic#: 92-025 ID#: 92BRD-013
Office: BRDEC
Contract #: DAAK70-93-C-0035
PI: Francois Zayek
Title: Underground Mine Detection Using X-Ray Backscatter Imaging
Abstract: We propose to design and develop a new x-ray detector system for use in underground mine imaging applications. The detector system will be designed to operate with a pencil-beam scanning x-ray source, and will detect the Compton interacted radiation that is scattered back toward the X-ray source. It will image horizontal views of thin layers of the underground structure. The detector we propose to use is cadmium zinc telluride (CdO-gZnO.2Te) which is a solid state detector. It is insensitive to vibrations and temperature change, consumes low power, is densely stacked, and has a response time better than 1 Ksec. The detector system will be designed to image layers of the ground with a voxel resolution of 2 cm cubes. The source-detector system will be insensitive to height variations, and will be designed to optimize backscatter radiation from the surface to 6 inches deep in the ground. This system could be successfully implemented with dual energy imaging if it determined necessary or desirable during Phase I. In Phase I we will evaluate experimentally a bench setup and image thin layers of soil. We will report the findings and present our recommendations for the development of a full system.

BIO-IMAGING RESEARCH, INC.
425 BARCLAY BLVD.
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Phone: (708) 634-6425
Topic#: 92-095 ID#: 92TEC-029
Office: TECOM
Contract #: DAAD01-93-C-0049
PI: V.C. Ravi Chandran
Title: Three-Dimensional Radiographic and Image Analysis for Defect Detection
Abstract: We propose to develop in this Phase I SBIR a technique to produce high-energy, multi-aspect radiographic images in near real-time, using a conventional real time radiography (RTR) system. This technique, stereo-pair imaging, will allow three-dimensional analysis of RTR images by producing two views, at different angles, of the object being inspected. The separate views will be generated by taking one view, rotating the object a small angle using the RTR system manipulator, and then taking the second view. The two views are displayed separately to each eye through a viewing adaptor; the operator's visual cortex easily combines the views to provide the inherent depth and positional information. The proposed approach is much simpler and less expensive than other stereo-pair approaches such as the use of a dual focal spot x-ray source. The only modifications that will need to be made to the RTR system are the addition of some software and the viewing adaptor. During Phase I we will optimize the design of the technique, write data acquisition software, and produce 3-D images for demonstration. In Phase II we will refine the software and develop the viewing adaptor, which will be available as an inexpensive upgrade to compatible RTR systems.

BIO-TECHNICAL RESOURCES
1035 SOUTH 7TH ST
MANITOWOC, WI 54220
Phone: (414) 684-5518
Topic#: 92-101 ID#: 92ARO-001
Office: ARO
Contract #: DAAH04-93-C-0006
PI: Alan D. Grund, PhD
Title: Development of Organic Solvent-resistant Microorganisms for Applied Bioprocessing
Abstract: The presence of high concentrations of organic solvents constitutes an extreme environment for microorganisms, yet little work has been done to isolate or develop microorganisms suitable for use under such conditions. There is a need for solvent-resistant microorganisms for use in a variety of such applications, including bioremediation, waste treatment, and

biocatalysis. We propose to isolate and develop solvent-resistant microorganisms which could be used for these purposes. Microorganisms capable of growth in the presence of 10% (v/v) organic solvent will be isolated by enrichment culture techniques, and through mutagenesis and selection. The catabolic abilities and solvent-resistance of these isolates will be characterized. We intend to clone the genes conferring solvent resistance in these organisms. This will allow rapid development of a wide range of solvent-resistant microbes for bioprocessing applications. The genes will also be placed in other microorganisms which have specific metabolic capabilities, thereby enhancing their utility. We will initiate studies dealing with the physiological basis of microbial solvent resistance. The goal of the Phase I research is to demonstrate that solvent-resistant microorganisms can be isolated, and to begin genetic and biochemical investigations on the basis of this resistance. The long-term goal is the development of technology for rapid creation of solvent-resistant microorganisms for use in a number of commercial applications of interest to both the Department of Defense and the private sector.

BIOELASTICS RESEARCH, LTD.
1075 SOUTH 13TH ST.
BIRMINGHAM, AL 35205
Phone: (205) 934-9510
Topic#: 92-069 ID#: 92NAT-066
Office: NATICK
Contract #: DAAK60-93-C-0040
PI: R. Dean Harris
Title: Synthesis of Novel Protein-based Elastomers
Abstract: Of the several protein elastomers - elastin, resiling, abduction, titin and twitchin- the elastomer with the greatest demonstrated durability is elastin. It is perhaps no coincidence that elasting is also most hydrophobic, as durability and hydrophobicity may be coupled. Also, greater hydrophobicity makes elastin-based elastomers of greater potential utilization alone and particularly in combination with traditional synthetic elastomers. Furthermore, elastin-based elastomers can be prepared with a wide range of elastic modula for a correspondingly wide range of applications. The objective of this basic research Phase I SBIR is chemically to synthesize three subsets of a family of model protein elastomers patterned after the dominant repeating elastic sequence of elastin. The approach in the design of the three subsets is systematically to increase hydrophobicity, yet retain the capacity to form structure by coacervation; to increase hydrophobicity in a manner that enhances cross-linking by y-irradiation; to increase hydrophobicity in a way that introduces pressure effects and shock absorbing properties; and to prepare elastomers with the potential for a range of elastic modula. The protein-based elastomers are to become more similar to, yet distinct from, traditional synthetic elastomers with respect to the properties to be examined. Those physical characterizations are to determine barrier properties, solvent swelling and flexibility at low temperatures.

BIOLOGICAL COMPONENTS CORP. (BCC)
3000 SAND HILL RD, BUILDING 4, SUITE 230
MENLO PARK, CA 94025
Phone: (415) 854-8070
Topic#: 92-103 ID#: 92ARO-034
Office: ARO
Contract #: DAAH04-93-C-0003
PI: Zhongping Chen
Title: Photosynthetic Reaction Centers as Active Molecular Electronic Components
Abstract: The aim of this project is the development of reaction centers from photosynthetic bacteria for use in molecule-based components and devices. Reaction centers (RCs) exhibit a remarkably highly efficient, extremely rapid, long-distance photoinduced charge separation under a wide range of conditions. The reaction center has electronic properties which are far superior, more flexible, and much less expensive to produce than any known synthetic donor/acceptor system. The key goal of the project will be to develop and to optimize strategies for the covalent attachment of reaction centers to electrode surfaces and to other reactive components. Molecular modelling will be used to decide among the many possible approaches, by evaluating the limitations and opportunities for each approach. If a well-defined interface can be fabricated between an ordered assembly capable of long-distance electron transfer and an electrode, then the potential for preparing light-driven molecular switches and novel sensors will have been realized. The long term objective is the design of molecular devices, including molecular switches and biosensors.

BRIMROSE CORP. OF AMERICA
5020 CAMPBELL BLVD, SUITE E
BALTIMORE, MD 21236
Phone: (301) 931-7200
Topic#: 92-049 ID#: 92CRD-022
Office: CRDEC
Contract #: DAAA15-93-C-0033
PI: Dr. Sean X. Wang
Title: A Miniature Biosensor Based Guided-wave Technology and Acousto-optic Tunable Filter

Abstract: Brimrose proposes to research and build in this SBIR Phase I program, a miniature optically based immunosensor for biodetection. By combining state of the art guide-wave technology, integrated optics and acousto-optics, this biosensor offers advantages of high sensitivity, extra fast speed, reliability, ruggedness, light weight, small size, low maintenance and potentially very low cost because of opto-electronic integration. In detection of biological agents, a novel Evanescent Guided-Wave Fluorescence (EGWF) method is used in which evanescent optical guided-wave in an optical waveguide is used to excite and collect the fluorescence from the bio-agents attached to the waveguide surface. The fluorescence spectral analysis will be performed by incorporating an Integrated Optic Acousto-Optic Tunable Filter (IOAOTF) which is monolithically integrated in the same waveguide.

BRIMROSE CORP. OF AMERICA
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BALTIMORE, MD 21236
Phone: (301) 931-7200

Topic#: 92-145 ID#: 92CRR-012
Office: CRREL
Contract #: DACA33-93-C-0015
PI: Dr. Sean X. Wang

Title: A Total Solid State, Extremely Fast, Highly Sensitive, Rugged, Miniature Spectroradiometer Based on a TeO2 Acousto-optic Tunable Filter (AOTF)

Abstract: Brimrose proposes to research and build in this Phase I program, a novel miniature spectroradiometer for measuring spectral incident, reflected, and transmitted irradiance of floating ice covers at visible wavelength (400-700 nm). This spectroradiometer is incorporated with a Brimrose acousto-optic tunable filter (AOTF). An AOTF uses an ultrasonic wave in a crystal to achieve fast and broadband spectral tuning. AOTFs are totally solid state devices with no moving parts, compact (1 cm cubed), light weight, and low power for battery operation. Because of that, the diameter of the submersible portion of the spectroradiometer is only about 5 cm. Since the AOTF can do self-calibration, no periodic maintenance is needed. In addition, the AOTF can be programmed to simultaneously pass multiple wavelengths, implement powerful matched filtering algorithms and the light throughput is independent of the resolution, which can greatly increase the sensitivity. As a side benefit, this spectroradiometer can also measure the polarization ratio of the light at different wavelength simultaneously. The fast tuning speed (10 ohms), high resolution (1-2 nm), high sensitivity, small size and inherent ruggedness of AOTFs make them ideal for low level light measurement under thick sea ice cover.

BUSEK CO., INC.
19 KEARNEY RD
NEEDHAM, MA 02194
Phone: (617) 449-3929

Topic#: 92-100 ID#: 92ARO-015
Office: ARO
Contract #: DAAH04-93-C-0011
PI: V. J. Hruby

Title: Synthesis of Fullerenes

Abstract: Busek Co. herein proposes a new fullerene synthesis process which was experimentally demonstrated and involves plasma breakdown of suitable hydrocarbons. The byproduct of the synthesis is hydrogen that can be sold or used on site for fuel cell based electricity production. Thus, two revenue bearing streams, fullerenes and H2 (or electrical power without CO2 emissions) are the product of the proposed process. Approximate cost analysis of the proposed and competing processes were performed and indicated that the plasma based fullerene synthesis could conceivably bring down their production cost to zero because all costs could be covered by the sale of H2 or electricity. In Phase I we propose to begin experimental fullerene yield optimization program (using existing equipment) via parametric variations of three process variables. Alternative fullerene purification process that involves supercritical fluids will also be investigated. The experimental program will be guided by concurrent analysis and the system cost analysis will be refined. Busek Co. will be assisted by SRI International. They currently produce fullerenes and already work with us on our AFOSR and SDI programs to develop a fullerene fueled space propulsion system. In Phase II the system will be scaled up and a prototypical system will be constructed and demonstrated.

CAMBELL ENGINEERING, INC.
3415 STANWOOD BOULEVARD
HUNTSVILLE, AL 35811
Phone: (205) 852-8720

Topic#: 92-053 ID#: 92MIC-061
Office: MICOM
Contract #: DAAHO1-93-C-R122
PI: Don W. Jones

Title: Solid Rocket Booster Starter System for Tactical Missile Turbojet Engines

Abstract: The turbojet engine starter system utilizes the pressure of the solid propellant boost motor to pressurize a fluid

contained in a bladder tank. The increase in fluid pressure ruptures a diaphragm containment seal allowing the fluid to flow through a boost motor/heat exchanger where the high pressure fluid is heated to high temperature. The heated fluid is used to spin-up rotors and to ignite the burner of the turbojet engine. The thermal energy input to the heat exchanger is from the products of combustion of the solid booster motor.

CAPE COD RESEARCH, INC.
19 RESEARCH ROAD
EAST FALMOUTH, MA 02536
Phone: (508) 540-4400
Topic#: 92-075 ID#: 92NAT-139
Office: NATICK
Contract #: DAAK60-93-C-0037
PI: Francis L. Keohan
Title: Environmentally Compliant Coatings for Waterproof Fabrics and Clothing
Abstract: Fabrics for rain gear and outdoor equipment have been traditionally rendered waterproof by coating with solvent-borne rubber solutions, solvent-borne polyurethanes and vinyl plastisols. Regulatory pressure for environmental and worker safety compliance has become a potent driving force in eliminating volatile organic solvents from commercial coating products. A variety of low solvent coating technologies are on the horizon to replace the traditional solvent-based coating methods. The proposed research explores the feasibility of applying current compliant coating methods to the problem of fabric waterproofing. The experimental thrust of the program explores the feasibility of using a combination of water-reducible formulation and UV curing to obtain an effective and environmentally benign waterproofing system for U.S. Army wet weather clothing.

CEMCOM RESEARCH ASSOC., INC.
1919 HALETHORPE FARMS ROAD
BALTIMORE, MD 21227
Phone: (410) 247-0012
Topic#: 93-029 ID#: 93WES-001
Office: CERL
Contract #: DACA39-93-C-0141
PI: Sean Wise
Title: Use of Recycled Plastic and Utility By-products For High Performance Cementitious Materials
Abstract: This proposal seeks to develop high performance concrete systems utilizing low grade recycled plastic resins and large amounts of industrial by-products such as fly ash. Our objective will be to make better construction materials than could be made without the waste products. Specifically, cementitious binders will be made that substitute more than fifty weight percent fly ash into cement/silica fume systems. This combination should alleviate the slow setting characteristics of the cement plus fly ash Portland-pozzolan cement systems, as well as the high shrinkage associated with high silica fume cement systems, while keeping costs competitive with standard concrete and giving a more durable material that is more tolerant of low quality aggregates. The systems are expected to maintain their tendency toward plastic shrinkage cracking, so chopped fibers made from low grade recycled resin will be incorporated to minimize this problem. The use of poltruded glass fiber reinforcing elements containing recycled plastic in their matrices will also be examined as this will increase the variety of plastics that might be used to make the chopped fibers. Primary applications for reinforced concretes such as these would be highly corrosive environments such as bridge decks in cold, moist climates or in marine construction.

CENTER FOR REMOTE SENSING
P. O. BOX 9244
MCLEAN, VA 22102
Phone: (703) 848-0800
Topic#: 92-031 ID#: 92C3 -028
Office: CECOM
Contract #: DAAB07-93-C-B762
PI: Suman Ganguly
Title: Ionospheric Propagation Predictions Using Satellite Beacon
Abstract: This receiver sets forth a plan to utilize commercial GPS receivers for real time ionospheric prediction at a remote location. The project will demonstrate the feasibility of using TEC measurements and evaluate the accuracy and applicability of these measurements for improvements in HF propagation. For this we assess the predictability of the slab thickness parameter T towards solar and geophysical parameters. Numerical models of thermosphere-ionosphere and the protonosphere will be used to obtain a self consistent physical description of the electron density distribution, slab thickness and their constituent parameters. Results of these simulations will not only allow a coherent assessment of the predictability of T and its constituent parameters but also will allow "parameterization" of the complex situation. These parameters will then be used to drive a simple self consistent 2-D ionospheric model for real time update.

(25)

CERACON, INC.
1101 N. MARKET BLVD. #9
SACRAMENTO, CA 95834
Phone: (916) 928-1933

Topic#: 92-003 ID#: 92ARD-027
Office: ARDEC
Contract #: DAAA21-93-C-0086
PI: Ramas V. Raman

Title: Advanced Refractory Metal Coatings Via an Innovative Powder Metallurgy Approach

Abstract: Armament Research Development and Engineering Center is interested in novel approaches to increase wear and erosion life of gun barrels. Prior work under the Advanced Materials for Gun Systems (AMGS) Program has identified that refractory metal alloys (tantalum-based) possess a balance of properties suited for this type of severe application. However, a processing methodology capable of bonding refractory alloys to a steel surface while retaining bond strength and microstructural control is desirable but not available. A Phase I program is proposed in which thermostructural modeling will be used to identify promising refractory alloys in collaboration with GE Armament Systems. Ceracon will apply an innovative cold isostatic processing approach to obtain a thin coating of refractory metal on the inner surface of steel. These materials will be fully densified and bonded using Ceracon's high pressure rapid consolidation process. Characterization and properties as well as wear erosion data, will be measured to enable down-selection of one coating material system for Phase II evaluation.

CERCOM, INC.
1960 WATSON WAY
VISTA, CA 92083
Phone: (619) 727-6200

Topic#: 92-021 ID#: 92AVS-115
Office: AVSCOM
Contract #: DAAJ02-93-C-0001
PI: Andre Ezis

Title: Selectively Reinforced Ceramic Matrix Composites for Bearing Races

Abstract: All-ceramic bearings offer high temperature capability, longer fatigue lifetimes, and lower weight compared to conventional steel bearings. However, the low fracture toughness of the ceramic material (typically silicon nitride) restricts the allowable hoop stress, and therefore severely limits their use for potential applications. Reinforcement of the ceramic matrix is a viable means to increase fracture toughness, although reinforcement of the bearing surface may induce fatigue crack initiation, result in differential wear rates and reduce attainment of fine surface finish. Consequently, a ceramic matrix composite (CMC) design with a monolithic bearing surface case and a higher toughness core region fabricated into a bearing race geometry is desirable. In this Phase I effort, techniques to fabricate silicon nitride with selective reinforcement (graded CMC) are conceptualized, demonstrated and evaluated by fabricating materials in selected geometries and thereafter characterized with respect to physical and mechanical properties. Fabrication techniques to be considered for producing selectively graded reinforced ceramic bearing races include: 1) centrifugal spinning of matrix based slurries containing particulate reinforcement(s), 2) selected high pressure molten metal infiltration to produce graded-tough cermets and 3) incorporation of refractory fibers for selected reinforcement.

CFD RESEARCH CORP.
3325-D TRIANA BLVD.
HUNTSVILLE, AL 35805
Phone: (205) 536-6576

Topic#: 92-012 ID#: 92AVS-064
Office: AVSCOM
Contract #: DAAJ02-93-C-0014
PI: Matthew E. Thomas

Title: Novel Inlet Protection System for Auxiliary Power Units

Abstract: The proposed Inlet Protection System (IPS) concept includes advanced T800 features and potential implementation of Electrostatic Particle Separation (EPS) technology. It is retrofitable into existing installations as well as integratable into future APU/SPU engines. CFDRC proposes an experimental/analytical team for CFDRC, Garrett Auxiliary Power Division (GAPD), and the University of Cincinnati (UC). The Phase I program includes: 1. application if GAPD IPS design procedures to assist in focusing CFDRC's proposed base line concept test program at UC; 2. IPS analytical wall contour optimization with and without implementation of EPS technology using advanced CFD analysis; 3. preliminary assessment and specification of scavenge requirements; and 4. documentation of CFD technology utilized to refine the IPS concept proposed here. Application of CFD technology during Phase I is expected to assist in early minimization of first stage compressor rotor excitation sources due to IPS inlet flow distortion. Phase II will consist of IPS prototype detailed design, fabrication, and sand removal efficiency testing. GAPD will assist CFDRC in assessment and implementation of all U.S. Army airworthiness requirements.

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Phone: (205) 536-6576
Topic#: 92-051 ID#: 92MIC-076
Office: MICOM
Contract #: DAAHO1-93-C-R095
PI: Matthew E. Thomas
Title: Tacital Missile Air Turbo Rocket Propulsion System
Abstract: An innovative approach is proposed for the development of a low cost Air Turbo Rocket (ATR) propulsion system by using off-the-shelf (OTS) component technology. The proposed ATR propulsion system will be capable of delivering up to 500 lbf boost thrust and 265 lbf of fully throttlable sustained thrust with a 10-1 turndown ratio. All propulsion module integration requirements will be focused toward a 5.85 inch diameter tactical missile airframe that can operate at a sea level sustained flight Mach Number of 1.5. Major activities during Phase I include: 1) optimization of critical ATR cycle parameters; 2) detailed vehicle mission analysis; 3) delivery and test support of OTS turbomachinery components; 4) analysis and conceptual design of ATR combustor technology; and 5) generation of an ATR module detailed design layout. During Phase II a flight weight ATR propulsion module will be developed by CFDRC and assembled in the MICOM propulsion laboratory. Phase III could consist of actual integration of ATR propulsion technology into a prototype test missile.

CHARLES RIVER ANALYTICS, INC.
55 WHEELER STREET
CAMBRIDGE, MA 02138
Phone: (617) 491-3474
Topic#: 93-017 ID#: 93MIC-030
Office: MICOM
Contract #: DAAHO1-93-C-R327
PI: James M. Mazzu
Title: A Neural/Expert Based Client Server Architecture for MITE ITS
Abstract: The hybrid integration of artificial neural networks (ANNs) and knowledge-based expert systems (KBs) is an ideal step in the development of intelligent systems. In general, the two methods complement each other such that ANNs provide soft constraints, while KBs allow hard constraints. Specifically, ANNs perform nonlinear functions, pattern recognition capabilities, fault tolerance and parallel processing; while KBs involve language processing, formal logic and rule interpretation. Here, we intend to exploit the complementary strengths of ANNs and KBs to create a hybrid multi-node, interactive, task-sharing, expert-instruction (MITE) intelligent tutoring system (ITS) with an object-oriented client/server architecture. The proposed effort will allow us to draw upon our achievements in adaptive modeling, task allocation, training systems, diagnostics and assessments, while incorporating the hybrid neural network/expert system methodology to provide a significant advancement in the development of a hybrid MITE intelligent tutoring system. Our current research efforts in the area of nuclear plant operations and aircraft task allocations will provide ideal candidates for the team-based problem-solving domains for which the hybrid MITE ITS will be developed.

CHARLES RIVER ANALYTICS, INC.
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Phone: (617) 491-3474
Topic#: 93-022 ID#: 93STR-002
Office: STRICOM
Contract #: M67004-93-C-0085
PI: Dr. Greg L. Zacharias
Title: Hybrid Simulator-based Intelligent Tutoring System
Abstract: The objective of the Phase I effort is to develop a generic simulator-based Intelligent Tutoring System (ITS) architecture and set of component module specifications. A primary design goal is to ensure that the architecture will support ITS upgrades of existing simulators as well as development of new ITS training devices. Our approach works within the conventional ITS framework of explicit agent representation (teacher, student, expert), and combines skill-based adaptive training techniques used in ARI's Intelligent Flight Trainer (IFT) project with structured knowledge-based diagnosis and syllabus modification used in MICOM's Intelligent Embedded Operator Assistant (IEOA) program. We propose an overall architecture that incorporates key features of both approaches with an emphasis on closed-loop operation of the man-machine trainer. Explicit cognitive models are used to represent student and expert, with several model "sites" reserved for capturing student/expert differences. Components of the tutor model are implemented via algorithmic, neural network, or expert system approaches, depending on the component requirements and the enabling technology capabilities. Proposed prototype implementation is in CASYS, an object-oriented graphical simulation language that can support the proposed hybrid solution.

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CHARLES RIVER ANALYTICS, INC.
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CAMBRIDGE, MA 02138
Phone: (617) 491-3474
Topic#: 92-160 ID#: 92MED-073
Office: MEDICAL
Contract #: DAMD17-93-C-3092
PI: Dr. Greg L. Zacharias
Title: Active Noise Cancellation Stethoscope
Abstract: The Phase I study will conduct a proof-of-concept demonstration of an active noise cancellation (ANC) stethoscope for auscultation of patient breath sounds during aeromedical evacuation. We believe that the most effective solution can be built around the use of ANC technology. By using a separate measurement of the acoustic noise environment surrounding the medic and patient, an ANC device can track the complex and time varying changes in the noise, and compensate for them in real-time. This provides the medic with a significantly enhanced signal-to-noise (S/N0 ratio, which, in turn, improves his ability to hear critical sounds and make the correct physical assessment of the patient. An initial demonstration will evaluate the performance of commercially-available ANC hardware, to identify basic performance levels and to identify critical design requirements to be met by the prototype system. A design effort will then focus on the development and evaluation of a state-of-the-art ANC stethoscope, with the ANC compensation specifically designed for in-rotorcraft auscultation. Engineering evaluation and psychoacoustic testing will be used to evaluate the Phase I prototype and define the development, validation, and documentation requirements of the Phase II effort.

CMTG RESEARCH, INC.
14 CASE ST.
NORTH CANTON, CT 06059
Phone: (203) 693-0639
Topic#: 92-080 ID#: 92TAC-037
Office: TACOM
Contract #: DAAE07-93-C-R019
PI: Gary M. Colello
Title: Non-hydraulic Suspension Actuators
Abstract: EASE (Electrically Adaptive Suspension Element) is comprised of three major sub-systems, these being the electromagnetic Coaxial linear (EMCL) actuator, the Adaptive Feedback Network, and the Thermal Management System. The EMCL actuator is designed for use as the active suspension element of a combat vehicle. The EMCL actuator is particularly suited to this adaptive architecture because the actuator is completely linear over its long travel, and has excellent frequency response, force and travel characteristics. The EMCL actuator is a hybrid brush-fed synchronous DC linear motor consisting of a helical conductor making up the bore of the cylinder and the mechanical support of the cylinder provided by an iron/fiberglass composite shell. The actuator will mount to a support frame in a manner similar to a conventional hydraulic actuator or snubber. The piston of the actuator consists of permanent magnet/black iron modules that provide thrust for actuation. The movement of the EMCL piston causes the actuator to distend or compress depending opon vehicle requirements. A set of bore guides is used to stabilize the piston in the bore while the bore guides also serve as an electrical conduit providing power to the piston and bore conductor. The basic design of the EMCL actuator is very similar to the electromagnetic actuator used for a torpedo countermeasures launcher that was designed, fabricated and successfully tested under a DARPA funded launcher effort. The proposed SBIR phase I work includes design, fabrication and testing for a complete EASE system which includes a computer controlled adaptive feedback network, electromagnetic coaxial linear actuator, power supply and power conditioning.

COLEMAN ENGINE CORP.
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LYNDEN, WA 98264
Phone: (206) 354-7513
Topic#: 92-014 ID#: 92AVS-082
Office: AVSCOM
Contract #: NAS3-26926
PI: Richard R. Coleman
Title: Single Rotor Turbine Expander
Abstract: Two forms of turbine expander are proposed. One, the single-rotor, partial admission, multistage, reentry type reaction turbine, is suitable for use at any realizable pressure ratio and should be especially effective in low mass flow engines because rotor blade Reynolds' numbers can be maximized for a given flow area. The other, a modified form of the radial flow turbine, is adaptable to and abets structural compactness in both conventional gas turbine engines and systems based upon high pressure ratio wave engines. Both expanders inherently increase the maximum allowable material-limited gas inlet temperature because of the temperature averaging effect of the gas streams. The unsteady gas dynamics involved in the reentry type reaction turbine requires the modification and upgrading of existing computer simulation programs in order to address some of the unique characteristics of this machine and provide data for the design of a laboratory test rig. However, current capabilities in

numerical techniques and modern computers permit effective solution of these problems. The performance and basic structural analysis of the radial flow turbine variant can be carried out with existing programs. These two expanders can drastically broaden the range of gas turbine propulsion applications.

COLONIAL CIRCUITS, INC.
1026 WARRENTON RD
FALMOUTH, VA 22406
Phone: (703) 752-5511
Topic#: 92-124 ID#: 92HDL-060
Office: HDL
Contract #: DAAL02-93-C-0047
PI: Bruce McCormick
Title: SERA Tester Application for Process Control
Abstract: This effort would develop the laboratory set-up of the solder ability tester into a real time statistical process control tool in the manufacture of printed wiring boards. By correlation of SERA test data to copper contamination levels in the solder plating bath; and the application of statistical process control techniques, real time feedback to the plating process would be established.

COMPUTER GRAPHICS SYSTEMS DEV. CORP.
2483 OLD MIDDLEFIELD WAY #140
MT. VIEW, CA 94043
Phone: (415) 903-4922
Topic#: 93-030 ID#: 93TOP-004
Office: TOP
Contract #: DACA76-93-C-0010
PI: Roy
Title: Texture Library for 3-Dimensional Visualization Systems
Abstract: A texture library is sought to serve DoD visual simulation training needs as well as civilian commercial applications. The design effort of the present study encompasses determination of pattern requirements, identification of methods for pattern generation, establishment of image generator requirements, identification of methods for categorizing patterns, and establishment of methods for compressing and distributing patterns.

COMPUTING SERVICES SUPPORT SOLUTIONS
6709 LA TIJERA BLVD., #451
LOS ANGELES, CA 90045
Phone: (213) 298-5309
Topic#: 92-041 ID#: 92SW-023
Office: CECOM
Contract #: DAAB10-93-C-0004
PI: Dr. Ananthram Swami
Title: Noise Reduction Techniques
Abstract: Signal Processing based on higher-order cumulants is a powerful tool to detect and estimate non-Gaussian signals in the presence of colored Gaussian noise of unknown power spectral density. Since signals used in communication systems are symmetrically distributed, the third-order cumulants (or bispectra) are theoretically zero, and hence, we are forced to use fourth-order cumulants (or trispectra). The blind equalization problem, in the presence of colored Gaussian noise, will be studied in this proposal. Existing algorithms, as well as proposed theoretical and practical extensions will be investigated. Both transversal as well as lattice structures, and algorithms based on conventional cumulants, as well as the trispectrum will be investigated. A candidate architecture amenable to implementation on existing signal processing hardware will be developed. Promising algorithms will be selected based on their theoretical performance analysis, the computational complexity, and their suitability to hardware implementation. Algorithms will be validated via simulations, and possibly against data to be obtained from the DoD.

CONTAMINATION STUDIES LABORATORY
201 EASR DEFENBAUGH ST.
KOKOMO, IN 46902
Phone: (317) 452-6651
Topic#: 92-124 ID#: 92HDL-058
Office: HDL
Contract #: DAAL02-93-C-0048
PI: Terry L. Munson
Title: Solder-plating Process Control
Abstract: At CSL, Inc. the Sequential Electrolytic Reduction Analysis equipment will be optimized for both board and component manufacturing processes. Six manufacturers will be supplying product during this project. Our approach to optimization will be through applying SERA technologies to all board and component processes that directly relate to the solder ability issues. CSL, Inc. will use a four phase approach with the objectives being correlation, redesign, multiple board analysis, and evaluation

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of component plating processes. By optimizing the technology through these four phases, we will be able to maximize the system areas of application as a process control tool. Using industry partners and an analytical laboratory approach, we can then maximize the exposure to the industry through a multidimensional test matrix. Understanding the type and level of oxides present throughout the metallization processes will lead to improved product quality. To give todays manufacturers cost affective process control tools that will improve product reliability can only save our industry uncountable millions of dollars and allow these manufacturers to better compete in the world market. CSL, Inc.'s use of both military approved and automotive electronic manufacturers will allow a more expedient commercialization of this technology.

CONTINUUM DYNAMICS, INC.
P.O. BOX 3073
PRINCETON, NJ 08543
Phone: (609) 734-9282

Topic#: 92-008
Office: AVSCOM
Contract #: NAS1-13810
PI: Dr. Todd R. Quackenbush

ID#: 92AVS-024

Title: Design and Control Strategies using Smart Structures Technology for Rotorcraft Maneuverability Enhancement

Abstract: Military rotorcraft will need a high degree of maneuvering capability to survive in the future battlefield operations. Conventional design methods and blade control technology offer only limited means for improving current maneuver performance levels. As a consequence, alternate technologies involving active control and "smart" materials are attractive since they offer the possibility of enhancing load factor, turning rate, and climb rate without penalties in vehicle utility. This proposal outlines an effort to evaluate the feasibility of new design and control strategies for rotor blades to improve maneuvering performance. These strategies will be based on the use of active control of twist and camber based on the application of Shape Memory Alloy (SMA) technology. This effort will combine advanced performance prediction and design optimization methods with recent work in rotor state estimation and control techniques to evaluate the improvements in rotor maneuverability available using actuators based on SMA technology.

CORDEC CORP.
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LORTON, VA 22079
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Topic#: 92-017
Office: AVSCOM
Contract #: NAS3-26922
PI: Dr. R. J. Weimer

ID#: 92AVS-089

Title: Fabrication of High Temperature Metal Matrix Composite Tubes by Vapor Deposition Methods

Abstract: Advanced turbine engines and flight vehicles will depend upon new, high-temperature metal matrix composites (MMC's) to meet performance goals. Engineering characterization of such materials is difficult and costly, which accounts for the meager property database available to designers. Thin-walled tubes would be especially useful for developing constitutive relations and failure criteria under multiaxial (T-C/Torsion) combined loads (thermal and mechanical, static and dynamic). This project will develop a process for manufacturing and consolidating MMC precursor wire into high quality tubular specimens by hot isostatic pressing. The MMC wire will be fabricated by a physical vapor deposition process which applies diffusion barriers (if needed) and matrix metal onto a continuous ceramic monofilament. The wire is a microcomposite of the final structure, carrying precisely the amount of matrix needed to achieve the desired final volume fractions. Phase I will establish the feasibility of this approach to making high temperature MMC thin-walled tubes. Phase II would demonstrate reproducible pilot scale production of high-quality tubes and, in the process, establish protocols for fabricating more complex engineering structures from these new materials.

COVALENT ASSOC., INC.
10 STATE STREET
WOBURN, MA 01801
Phone: (617) 938-1140

Topic#: 92-115
Office: ETDL
Contract #: DAAL01-93-C-3311
PI: Dr. Larry A. Dominey

ID#: 92ETD-031

Title: High Rate, Solid Inorganic Polymer Electrolyte-based Bipolar Lithium Batteries

Abstract: The U.S. Army requires safe, high rate, high energy density rechargeable bipolar Li batteries to power a wide range of manportable electronic equipment. Although remarkable strides in solid polymer electrolyte (SPE) technology for rechargeable Li batteries have been made, serious problems with safety, rate, and energy density still remain. In this proposal we address three specific areas of SPE technology requiring advances by way of new materials: 1. a chemically and electrochemically stable solid inorganic polymer electrolyte (SIPE); 2. high rate, easily prepared thin film sol-gel LiCo02

cathodes; 3. Li reactivity inhabits which prevent uncontrolled thermal excursions. During Phase I bipolar laboratory cells comprising Li foil/SIPE/LiCo02 will be built and cycled paying particular attention to rate capability, self-discharge at 60C, and cycle life.

CREW SYSTEMS CONSULTANTS
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Topic#: 92-015
Office: AVSCOM
Contract #: NAS2-13811
PI: Richard L. Newman

ID#: 92AVS-083

Title: Helmet-Mounted Display Flight Symbology and Stabilization Concepts

Abstract: A program to investigate symbology and symbology-stabilization concepts for helmet-mounted displays (HMD) has been proposed. The present implementation of HMD symbology as defined in MIL-STD-1295 has been found to cause increased pilot workload and may present hazardously misleading cues in some instances. The Phase I program will identify unresolved issues and propose candidate solutions for correcting these problems. The Phase II effort will conduct ground simulation and in-flight evaluations of these candidate solutions. A strawman HMD design standard will be developed.

CYBERNET SYSTEMS CORP.
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Topic#: 93-016
Office: MICOM
Contract #: DAAHO1-93-C-R318
PI: Brian T. Mitchell, PhD

ID#: 93MIC-103

Title: Reducing Teleoperated System Data/Image Bandwidth Requirements using a Quantitative Model of UGV Operator Focus of Attention

Abstract: The need to transmit video information greatly exceeds the current capability to transmit this information for many military applications. This statement is absolutely true in the teleoperation of semi-autonomous robotic land vehicles where the remote operator needs advanced video compression techniques to support low data rate and supervised driving modes. This proposal advocates the development of a data compression scheme based on an active vision focus of attention model. The overall approach leverages the current understanding that the uniqueness of preattentive parallel features is the primary factor associated with determining visual focus of attention, and is coupled with a current understanding of the processing found within the motion detection channel of the human vision system to produce a technique that is computationally attractive. This overall approach directly leverages Cybernet's previous DARPA work developing an Interface Evaluation System (eye-tracking and operator monitoring). The outcome of this effort is directed at producing software which will function on the Portable OCU Cybernet is building for the DARPA Demo II program, and promises to significantly reduce the data bandwidth required to perform semi-autonomous vehicle navigation on this unit. We believe this project will provide significant technical leveraging to many UGVJPO projects.

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Topic#: 93-026
Office: HEL
Contract #: DAAA15-93-C-0037
PI: Charles J. Jacobus, Ph.D.

ID#: 93HEL-013

Title: Concept to Control -- Using Virtual Reality to Test UGV Man-machine Interfaces and to Control UGV Systems

Abstract: Many man-machine interface features of the modern unmanned ground vehicle control station require sophisticated trade-offs be made. For instance, the need to transmit video information from a vehicle for teleoperation greatly exceeds the current capability of military radios to transmit this information. The remote operator needs advanced video compression techniques to support low data rate and supervised driving modes which involve trading off bandwidth with temporal lag, image resolution, and frame update rate. This proposal advocates the development of an approach to control interface design based on operator focus of attention modeling. Our approach is to enhance early man-machine interface (MMI) definition through a virtual reality environment for UGV control which supports implementation of a rapid succession of prototype user control interfaces. These MMIs inherently incorporate metering, i.e. quantitative measurement of operator performance for benchmark mission activities. The overall approach leverages the current art in constructing virtual reality systems and new technology in human operator response metering developed at Cybernet (for DARPA). Also work now underway at Cybernet to develop an advanced multiple vehicle operator control station for DEMO II provides an ideal path for technology migration into main

line US Army UGV program activities later.

CYBERNET SYSTEMS CORP.
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Phone: (313) 668-2567
Topic#: 92-147 ID#: 92TOP-009
Office: TOP
Contract #: DACA76-93-C-0003
PI: Cyril S. White
Title: Personal Navigation and Reporting
Abstract: Due to the increasing use of technology to plan and implement modern day combat, it is imperative that troop and vehicle deployment and position be known as precisely as possible. Furthermore, the unit commander must be able to quickly plan, transmit, and display friendly and adversarial troop and vehicle locations to coordinate battlefield operations effectively in the heat of battle. In this effort we propose to develop a Personal Reporting and Navigation System (PNRS) subsystem using non-developmental item navigations aids (GPS, INS, Magneto Compass, etc.), and UHF radio with data interfaces. This system will also provide a unique solution to the problem of ground based friend or foe identification. In phase I we will demonstrate a conceptual implementation of the system using commercial components. In Phase II complete architecture integration will be done based on Phase I Results.

DAINA
4960 FILLMORE STREET, N.E.
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Phone: (612) 781-7600
Topic#: 92-032 ID#: 92AV-021
Office: CECOM
Contract #: NAS1-20035
PI: Dr. Paul R. Pukite
Title: Advanced Design Tools for Evaluating Fault-tolerant Systems
Abstract: As mission critical avionics systems increase in complexity, the evaluation of their performance and reliability will become more difficult. We propose to select and to integrate a group of reliability and performance analysis tools, specifically designed to handle the fault-tolerant operational aspects of the next generation avionics architectures. These tools will support both hardware and software evaluation and will be developed in the Ada programming language. The reliability analysis will use a customized CARMS program (computer-aided rate modelling and simulation), with an interactive graphical and spreadsheet interface. The performance analysis tools will use Petri net analysis and Monte Carlo simulation methods. An embedded Ada expert system will help to guide the proper method selection and to control the evaluation and sensitivity analyses. Personal computers will be used for the initial prototyping and simulation. We expect that the availability of these tools will permit earlier evaluation of the effectiveness of the selected architecture, and thus avoid the need for later changes in the design. Our earlier experience with the PAVE PILLAR avionics architecture, embedded expert system design, and fault-tolerant system analysis and simulation methods will provide a sound foundation for this project.

DANIEL H. WAGNER ASSOC., INC.
STATION SQUARE TWO
PAOLI, PA 19301
Phone: (215) 644-3400
Topic#: 92-176 ID#: 92SDC-077
Office: SDC
Contract #: DASG60-93-C-0014
PI: Dr. Barry Belkin
Title: Real-time Determination for Kwajalein Missile Range (KMR) Tracking Development
Abstract: Current KMR experience is that the complexity and uniqueness of some reentry objects cause atmospheric drag profiles to deviate significantly from model predictions. The possible result is loss of track. As a consequence, there is a need to develop a tracking filter which allows for the accurate real time estimation of drag. The objective of the proposed Phase I effort is to investigate the performance of an empirical method for real time drag estimation based on the use of a modified Euler method to predict object location combined with the use of the Rauch-Tung-Streibel smoother to estimate total body acceleration A. The deceleration due to drag AD can then be estimated from A and the known gravitational acceleration AG. The primary Phase I task proposed includes: (1) the design of the tracking algorithm, (2) the adaptation of existing test bed software to support the testing of the tracking algorithm, (3) preliminary algorithm testing, and (4) documentation of the algorithm design and test results.

DASGROUP
3807 ELMHURST ROAD
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Phone: (419) 537-2116
Topic#: 92-050 ID#: 92CRD-034
Office: CRDEC
Contract #: DAAA15-93-C-0015
PI: Douglas A. Smith
Title: Quantum Chemistry Visualization Using AVS
Abstract: Molecular modeling is widespread in a variety of federal, industrial and academic laboratories. Graphical interfaces have become the rule, yet quantum chemistry visualization lags far behind other modeling even though quantum calculations account for almost half of the cpu cycles used. In order to address this need, DASGroup will develop a hardware independent graphical user interface based on Application Visualization System (AVS) for the analysis of quantum mechanical calculations of molecular properties. This GUI will be capable of property calculations, visualization, real time manipulation, and animation of results produced by the Gaussian and MOPAC series of programs. DASGroup will compile a computer searchable calculable properties data base for Gaussian and MOPAC, prepare a feasibility study and timetable for converting MOPAC completely into AVS for real time control and visualization of semiempirical calculations, and will demonstrate the visualization and animation of between 1 and 5 calculated molecular properties. DASGroup's ultimate goal is to design and implement MOPAC-AVS, an interactive real time visualization version of MOPAC, and a fully functional molecular modeling graphical user interface for Gaussian, MOPAC, and other quantum codes.

DASGROUP
3807 ELMHURST ROAD
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Phone: (419) 537-4028
Topic#: 92-130 ID#: 92MTL-136
Office: MTL
Contract #: DAAL01-93-C-4037
PI: Charles W. Ulmer, II
Title: Rational Design of Novel Transparent Ballistic Polymers
Abstract: Molecular modeling for drug design is a reasonably mature science, but the techniques have not yet been applied to most other areas of polymer design. In order to develop transparent polymers with greater protection against ballistic impact, we will develop a modeling protocol for bisphenol-A-polycarbonate (PC), polymethylmethacrylate (PMMA) and Astrel 360 polysulfone (PES) utilizing semiempirical molecular orbital and molecular mechanics calculations of model systems and molecular dynamics of amorphous polymers. Modeling results of different polymers and of the same polymers under different conditions will be compared with each other and with experimental data to determine what structural elements of PC give it it's unique ballistic properties. Structure property relationship analysis using the newly available software package QSPR-Polymer will allow pre-modeling screening of hundreds of derivatives based on PC, PMMA and PES. Promising QSPR candidates will be cycled through the modeling protocol in order to enhance our understanding and hypotheses, which will ultimately lead to the proposal of new transparent polymers with significantly improved ballistic performance.

DCS CORP.
1330 BRADDOCK PLACE
ALEXANDRIA, VA 22314
Phone: (703) 683-8430
Topic#: 92-004 ID#: 92ARD-051
Office: ARDEC
Contract #: DAAA21-93-C-0009
PI: James Lincoln
Title: Low Intensity Conflict Aerosol Munitions
Abstract: Aerosol sprays of paint, epoxy, and other substances can be dispensed by mines and other munitions to disable hostile sensors, vehicles, and weapon systems. For example, a paint-filled aerosol mine could be designed to detect an approaching vehicle, pop into the air, and eject and aerosol mist of opaque, brightly colored, solvent resistive, electrically conductive paint at the vehicle. The resulting coating would disable periscopes, vision blocks, windshields, headlamps, lasers, and night vision devices as well as destroy vehicle camouflage. The electrically conductive nature of the paint would serve to ground out communications antennae and disrupt or incapacitate radar/dishes. Tanks and armored vehicles with paint-coated optical surfaces would be hazardous to occupy and their weapon systems would be difficult to employ. Aerosol munitions could be tailored to fit existing mines, mortar rounds, artillery shells, UAV's or missile warheads, thus making them an inexpensive addition to existing inventories. DCS proposes to list and categorize all such aerosol munitions, determine Army requirements, formulate concepts for specific aerosol munitions, and devise optimized functional specifications for at least two types of non-lethal aerosol munitions.

DECISION-SCIENCE APPLICATIONS, INC.
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Phone: (703) 243-2500
Topic#: 92-139 ID#: 92VAL-004
Office: VAL
Contract #: DAAL01-93-C-2006
PI: Philip G. Tomlinson
Title: Bistatic Chaff and Weather Modeling
Abstract: It is proposed to develop a mathematical model for the bistatic signature of chaff, as well as weather (rain and fog). The model will include the full scattering matrix and temporal and spatial amplitude and phase fluctuation statistics. The model will be parametric in such factors as the electrical length of the chaff dipoles, wind turbulence, and radar resolution volumes. DSA proposes to build upon work in resonance region scattering approximations for dipoles, numerical electromagnetic techniques, atmospheric modeling, and DSA software tools for synthesizing probability density functions.

DEFENSE RESEARCH TECHNOLOGIES, INC.
354 HUNGERFORD DR
ROCKVILLE, MD 20850
Phone: (301) 762-3077
Topic#: 92-128 ID#: 92HDL-084
Office: HDL
Contract #: DAAL02-93-C-0010
PI: Tadeusz M. Drzewiecki
Title: No-moving-parts Electrolytic Oxygen Pump for Low Noise Fluidic Applications
Abstract: DRT proposes to develop a novel no-moving-parts pump that delivers flow of oxygen-enriched air, on the order of liters per minute at any desired pressure, without any pulsations or flow noise. A pump operating off a vehicular battery could weigh less than 8 lb. with a size of less than 1 cubic foot. It is based on a demonstrated chemical and biological agent purifying oxygen pumping system, where, in the electrolytic process, a partial pressure of oxygen is developed due to ion flow across a solid electrolyte (yttrium-doped zirconia) in the presence of an electric potential. This pump promises to be the low noise power supply to use with ultrahigh dynamic range, high sensitivity acousto-fluidic devices and other (e.g. inertial) sensors. It will deliver quiet flow on par with, or better than that of bottled compressed air. Cost could be very low due to its simplicity. DRT will test existing oxygen pump hardware and establish overall performance characteristics and will then develop a preliminary design for implementation in a Phase II effort. Also, DRT proposes to identify and assess other fluid power sources in order to provide the Government with a basis for establishing tradeoffs for manportable verses vehicular verses other applications. A survey of power supplies to include other electrolytic processes, chemical and thermal, would be conducted. Characteristics considered will include pnrumatic power required by typical fluidic systems, allowable noise levels, system robustness, source input power requirements (efficiency) and cost.

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Phone: (408) 734-2400
Topic#: 92-084 ID#: 92TAC-078
Office: TACOM
Contract #: DAAE07-93-C-R023
PI: Ted Batha
Title: Advanced Supervisory Systems
Abstract: Combat vehicle functions and capabilities are becoming increasingly complex. The introduction of computer control architectures in vehicles and vehicle subsystems provide an abundance of information to operating crew members. This increased information load coupled with reduced crew sizes allocated to operate these vehicles creates a major problem. Therefore, the need arises for an intelligent, computer based supervisory system to monitor vehicle operation and advise crew member(s) of key events as they occur. This supervisory system would employ advanced knowledge-based reasoning technologies embedded into the vehicle's status monitoring and control operations to significantly reduce operator workload.

DIRECTED TECHNOLOGIES, INC.
4001 N. FAIRFAX DR, SUITE 775
ARLINGTON, VA 22203
Phone: (703) 243-3383
Topic#: 92-102 ID#: 92ARO-041
Office: ARO
Contract #: DAAH04-93-C-0005
PI: George N. Baum
Title: High Pressure Hydrogen Supply for Increased Fuel Cell Efficiency
Abstract: Fuel cells are being considered by the Army for future individual soldier power supplies. These power units are to be lightweight, compact and suitable for use on the battlefield. A compact, lightweight, safe source of pure hydrogen (and possibly oxygen) is urgently needed. The proposed report will examine a series of high pressure hydrogen and liquid hydrogen

storage systems suitable for an individual soldier's power supply. Incorporation of high pressure H2 storage into the power system is felt to simultaneously simplify the system while reducing the size/weight of the fuel cell and boosting system efficiency. An air compression system operated by the expansion of high pressure gases will be conceptually designed to allow "supercharging" of the fuel cell stack. Fuel cell power systems which carry an oxidant supply in addition to a hydrogen supply will also be examined as a possible means of boosting fuel cell efficiency and reducing combined fuel cell/storage system weight and cost.

DOVE ELECTRONICS, INC.
227 LIBERTY PLAZA
ROME, NY 13440
Phone: (315) 336-0230
Topic#: 92-091 ID#: 92TEC-035
Office: TECOM
Contract #: DAAD09-93-C-0015
PI: John F. Dove
Title: Remote Site Wind Measurement Capability
Abstract: Dove Electronics, Inc. has designed and fabricated the most advanced active scintillometer for measuring wind speed, wind direction and atmospheric turbulence for the U.S. Army and the National Oceanic and Atmospheric Administration. This device is called HOLODAR and achieves its superior performance through the use of multiplex holographic optical spatial filters. We are now proposing a smart passive scintillometer to meet the TECOM need for a high performance passive scintillometer for measuring wind parameters. This device will achieve high performance through the use of fractal theory, wavelet theory, neural networks, extensive scene and image design and test databases. This effort will also use an enhanced version of the theory of passive wind sensing found in the "Theoretical Analysis and Experimental Evaluation of a Prototype Passive Sensor to Measure Crosswinds", by Clifford, Ochs and Wang dated September 1974. The key to a successful design and fabrication of an outstanding passive scintillometer is the formulation of an effective way to process and exploit the varying uncertainties and complexities in the naturally illuminated scenes. The large database of images and naturally illuminated scenes will form the starting point of the required analysis. It is anticipated that a smart sensor will provide best performance in a wide variation of scene dynamics.

DUNCAN TECHNOLOGIES, INC.
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NEWCASTLE, CA 95658
Phone: (916) 888-6522
Topic#: 93-029 ID#: 93CER-049
Office: CERL
Contract #: DACA88-93-C-0013
PI: David B. Duncan
Title: Structural Composite Construction Materials Manufactured From Municipal Solid Waste
Abstract: Development of a structural plywood substitute derived from paper fiber and thermoplastic materials found in municipal solid waste is proposed. We will develop a process to manufacture a composite product made from thermoplastic materials reinforced with wood fiber derived from municipal waste paper. The resulting material will provide good strength and modulus while retaining the degradation resistance of the polymer matrix. Candidate products will be tested for tensile, compression, and flexural strength. Once all parameters of the material process have been developed, a preliminary design of a sub-scale pilot plant will be completed. This pilot plant will be built in the Phase II program. A market analysis will study existing wood and wood fiber based products to identify market sectors where our product is competitive. An economic analysis of the proposed process will determine the unit cost of candidate products and evaluate their commercial viability relative to existing wood and fiber based products.

DYNA EAST CORP.
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PHILADELPHIA, PA 19104
Phone: (215) 386-4884
Topic#: 92-001 ID#: 92ARD-052
Office: ARDEC
Contract #: DAAA21-93-C-0010
PI: William J. Flis
Title: An Improved Munitions Container for Reduced Hazard Classification
Abstract: We propose to develop an improved multi-purpose munitions container with reduced hazard classification and ability to pass the fast cook-off test. The currently yielded container, when loaded with munitions and exposed to a large fuel fire, acts as a pressure vessel to contain the product gases evolved form the burning munitions inside, until it catastrophically ruptures, with a release of fragments and possible projection of munitions. Using special materials and design features, these containers will be modified to first thermally insulate the contained munitions from the fast cook-off environment; to vent the internal

pressure of evolved gases or to fail in a controlled, non-fragmenting manner; and finally, to protect the contained munitions from fragments projected by nearby detonating munitions.

DYNETICS, INC.
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Phone: (205) 922-9230
Topic#: 92-033 ID#: 92EW-036
Office: CECOM
Contract #: DAAB07-93-C-U260
PI: Dr. Chris Anderson
Title: Nonlinear Techniques for Impulse Radar Electronic Support Measures (ESM)
Abstract: Impulse response radars present a major detection problem for current and developmental Electronic Support Measure (ESM) receivers. These signals are characterized by short pulse durations and wide bandwidths, for which current and developmental ESM receivers are not optimized. Detection and characterization of received radar impulses would enable classification of the emitting radar source, including measurement of pulsewidth and pulse repetition frequency. Dynetics proposes a novel nonlinear signal processing approach to solve the impulse and ultra-wide-band radar detection problem. Specific advantages of nonlinear approaches are: 1. Narrowband signals from a dense signal environment are removed prior to pulse detection, 2. Input signal-to-noise ration (SNR) is not degraded, and 3. Pulse detection is performed in the time domain (SNR optimized). To analyze linear and nonlinear detection algorithms, Dynetics has developed an ESM computer simulation. Simulation results are provided to illustrate the benefits of this type of impulse detection. Specific issues to be resolved during Phase I include assessing intercept receiver requirements, specification of nonlinear processing techniques for the detection, characterization, and direction finding of impulse radars, and selection of an optimal approach. In addition, a preliminary design and analysis of the optimal ESM receiver will be performed.

DYNETICS, INC.
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Phone: (205) 922-9230
Topic#: 92-062 ID#: 92MIC-060
Office: MICOM
Contract #: DAAHO1-93-C-R125
PI: B. V. Dasarathy
Title: Advanced Signal Processing Techniques for BAT-Class MMW Seekers
Abstract: Among the most demanding problems for millimeter wave (MMW) radar guided missiles such as that being developed for the Brilliant Antitank (BAT) program is the detection and classification of stationary ground targets in clutter rich environments for autonomous acquisition and terminal homing. This mission must be met with a high probability of successful classification and a minimal false target density (FTD) to best utilize interceptor resources. The threat for these missions consists of the modern tank formation, assembly areas, choke points, and high-value targets. In addition, it is desirable to commit resources against tanks rather than lower-priority vehicles such as trucks. More sophisticated signal processing techniques are required to detect and classify stationary targets with high probability in a clutter-rich environment (including snow) and to perform aimpoint selection and biasing. Nontraditional techniques include the use of wavelet transformations, fractal-based feature extraction, and neural network processing. Specifically, a MMW seeker will be designed and simulated that will include a wavelet transform processor, a detection and segmentation subsystem, a feature extractor that incorporates a fractal dimensionality feature, and a neural network classifier. Collected data (such as collected under the MLRS/TGW program) will be used to test the system.

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Phone: (410) 676-1449
Topic#: 92-079 ID#: 92TAC-017
Office: TACOM
Contract #: DAAE07-93-C-R017
PI: Mr. Matthew Hutton
Title: Computer Simulation Modeling of NBC Sensor Capabilities on Ground Vehicles
Abstract: The technology growth and widespread expansion in the number of nations, particularly among third world countries, possessing or acquiring nuclear, biological, and chemical (NBC) weapons have dramatically altered the NBC threat of U.S. military forces. This worldwide proliferation of an NBC offensive capability indicates that U.S. forces must have an integrated NBC defense which includes NBC sensors on ground vehicles in order to operate and survive on the future multi-threat battlefield. Critical to developing and implementing a strong operationally supportive NBC defense posture is the requirement to integrate NBC effects into wargames and simulations. This project will perform a worldwide market survey and technology

review to evaluate existing military, commercial, and developmental NBC sensors for use on U.S. Army ground vehicles. Laboratories, military equipment compendiums, subject matter experts, information analysis centers and other on-line data bases will be utilized. The feasibility of imbedding and/or interfacing NBC models into existing force-on-force models will be assessed. These results will provide the framework for developing a simulation that accurately models NBC insults and their effects against both system/crew and a force within existing COEA force-on-force models.

ELECTRO-OPTEK CORP.
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TORRANCE, CA 90505
Phone: (310) 534-3666
Topic#: 92-035 ID#: 92EW-049
Office: CECOM
Contract #: DAAB07-93-C-U756
PI: Eugene L. Dines
Title: Dual-mode Imager for Positive Identification of Friendly Vehicles in Combat
Abstract: We propose to develop a dual-mode sensor for positive all-weather identification of friendly vehicles in combat using 2-dimensional arrays of All-xGaxAs multiple quantum wells (MQWs) for detection long-wavelength infrared (LWIR) radiation and 2-dimensional arrays of 94-GHz millimeter wave (MMW) transceivers. The former will be fabricated by plasma-assisted metalorganic molecular beam epitaxy (PAMOMBE) and the latter by plasma-enhanced chemical vapor deposition (PECVD). In Phase I, we will first develop electron-cyclotron-resonance (ECR) sources for reactive epitaxy on insulating GaAs substrates, followed by the development of MQW IR detectors. We will design the sources and ultra-high-vacuum fixtures for epitaxy and delineate the PAMOMBE processes to grow MQW devices at a high growth rate and with high-quality epitaxy, and thus cost effectively. 94-GHz MMW integrated circuits will be designed and simulated. In Phase II we will fabricate several MQWs one on top of another forming a vertical stack of IR detectors, each responding to a different spectral band. We will then fabricate a prototype 2-dimensional array of these stacks for multispectral IR imaging and integrate it with a two-dimensional 94-GHz MMW array into a high-performance dual-mode sensor providing real-time and positive non-cooperative identification of friendly forces in combat in all weather conditions.

ELECTROMAGNETIC APPLICATIONS, INC.
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BOSTON, MA 02109
Phone: (617) 720-3968
Topic#: 92-110 ID#: 92ETD-024
Office: ETDL
Contract #: DAAL01-93-C-0270
PI: Hoton How
Title: Design of Wide-band Self-biasing Drop-in Microwave/Millimeter Wave Circulators
Abstract: In this proposal the possibility for wide-band operation of a drop-in circulator has been discussed based on a recent patent disclosure. For this purpose two approaches have been attempted. Since the circulator is biased below resonance, frequency tracking conditions may be obtained via suitable use of the dielectric filling material and the subtension angle of the circulator pots. It is hoped that octave bandwidth operation of the device can be ultimately realized. The second approach is based upon the operational principles relating to a waveguide partial-height ferrite junction circulator. Since the field profile in the drop-in circulator junction is analogous to that associated with the partial-height ferrite in a waveguide junction, we believe that the bandwidth of a drop-in circulator can be extended to at least 30% of its center frequency by using metal transformer with a pinning stub. Finally, we propose that hexagonal ferrites shall be used in the fabrication of millimeter wave devices. This eliminates the need of external biasing field even at high frequency operation of the circulator.

ELLIOT DAVIS
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Phone: (716) 691-7235
Topic#: 93-025 ID#: 93S3I-005
Office: HDL
Contract #: DAAL02-93-C-0068
PI: Elliot Davis
Title: Decorrelation of Noise by Means of Error Templates
Abstract: To explore the utility of adaptive techniques based on explicit characterization of interfering sounds in the design and development of robust acoustic detection and classification. DESCRIPTION: Previous work (Patent 4,802,231) has shown that with proper adaptive learning schemes, interfering acoustic signatures (which tend to obscure or be misrecognized as one of the desired signatures) can be automatically identified, characterized, compared to and deleted from an incoming acoustic data stream. This process enhances the effective signal to clutter ratio and may expose a desired signature buried in a very obscure environment. In a typical use of this approach, sounds that tend to obscure or be training and on the fly, into templates defining

error classes. These templates are then used to identify and suppress signals from template matching against reference templates. RESEARCH: Develop and code algorithms and exercise in a suitable simualtion testbed. Effort focused on demonstrating ability to perform detection and upon classification accuracy, rather than on real time performance.

ENERGY CONVERSION DEVICES, INC.
1675 WEST MAPLE ROAD
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Phone: (313) 280-1900
Topic#: 92-077 ID#: 92TAC-008
Office: TACOM
Contract #: DAAE07-93-C-R014
PI: Krishna Sapru
Title: Application of Thin Film Thermoelectrics
Abstract: The objective of this program is to develop a thin/thick film materials deposition process technology which will reliably provide high quality materials for constructing Peltier thermo-elements with a high figure of merit over the temperature range of 250-350 Deg K. The study will focus on the materials system consisting of (B1, Sb)2(Te, Se)3 alloys for both p- and n-type thermo-elements. Literature shows that specific compositions in this alloy system have provided high figures of merit (3.2 - 3.4 x IO-3/Deg K at 3OOK) with a maximum Peltier cooling of 77 Deg K. Recently investigators at the University of Virginia reported a high figure of merit of 3.7 x 10-3/K for p- type (Bi, Sb)2(Te, Sb)3 alloy. The process selected for depositing the films in the proposed program will be a unique, high rate Microwave Enhanced CVO process (MECVD) developed at Energy Conversion Devices, Inc. ECD has achieved deposition rates as high as 3OO Deg. A/sec for amorphous Si-H alloys using this technique, and this process has been developed for deposition on large area surfaces. Large area thin/thick film thermoelectric modules will be attractive for applications which require heating/cooling ability in a single, light-weight module.

ENGINEERING DEVELOPMENT CORP.
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AMES, IA 50010
Phone: (515) 232-5944
Topic#: 92-080 ID#: 92TAC-041
Office: TACOM
Contract #: DAAE07-93-C-R020
PI: Jerald M. Vogel
Title: Development and Demonstration of a Non-hydraulic Actuator for Application in Active and/or Semi-active Suspension Systems
Abstract: A program for the preliminary design, prototype construction, and bench testing of a linear pneumatic suspension strut for application in non-hydraulic combat vehicle suspension systems is presented. The proposed suspension strut system components include an air spring, accumulator, and variable size orifices for the active control of strut dynamic performance. Strut natural frequency, damping ratio, and strut extension are independently adjustable parameters over a specified range of values through controlled sizing of the system airflow orifices and an air source. An optimal control study using a classical Calculus of Variations (Mayer Formulation) approach is proposed to determine the feasibility of the strut in an active control system for a quarter vehicle model. System objective functions under consideration include various combinations of vehicle ride quality and controllability. The proposed effort includes a detailed design of the linear suspension strut and bench testing to verify strut natural frequency and damping ratio ranges.

ENIG ASSOC., INC.
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Phone: (301) 593-4471
Topic#: 92-105 ID#: 92BRL-005
Office: BRL
Contract #: 93C-0043
PI: Dr. D. John Pastine
Title: Design of a MAHEM Shaped Charge Warhead
Abstract: We describe our novel concept of a magnetohydrodynamic explosive munitions (MAHEM) and apply it to the design of a shaped charge. The MAHEM is an explosive warhead that utilizes magnetohydrodynamic effects to transfer the "global" explosive energy (that is mainly wasted in a conventional warhead) at electromagnetic speeds to a "localized" region where it may act on the metal mass of a shaped charge cone that is to be propelled in a given direction toward a target. Our concept exploits the phenomenon of electromagnetic braking for the purpose of transforming the kinetic energy of detonation products in one part of a system to kinetic energy of metallic ejecta in another part. Hence, the local region can become a region of huge energy accumulation. It should be possible to propel metallic ejecta at velocities much greater than can be done using explosives alone...or to propel a much greater mass...in order to obtain greater kill probabilities. Methods for doing this are outlined, and some examples are provided. The explosive used in the MAHEM can be a truly insensitive explosive, e.g. TABT, resulting

39

in invulnerability to accidental detonation.

ENSCO, INC.
5400 PORT ROYAL RD.
SPRINGFIELD, VA 22151
Phone: (703) 321-4540
Topic#: 92-005 ID#: 92ARD-037
Office: ARDEC
Contract #: DAAA21-93-C-0016
PI: John Perry
Title: Non-destructive Testing From Fuzed Data
Abstract: Nondestructive inspection using fused data from diverse inspection sensors has the potential to characterizing defects within ordnance items which may not be characterized properly by one sensor only. Data from different NDI methods are often complementary, thereby adding diagnostic information to help lead the inspection to the correct decision about the disposition of a defect. The objectives of the Phase I proposed effort are to design and implement a technique for fusing nondestructive sensor data. We will develop the fusion system for a specific problem that confronts Picatinny Arsenal in the analysis of ordnance items. In addition, we will design the fusion system to be general enough to fuse any type of sensor data. The general objectives of the Phase I project are to lay down a foundation for developing a robust image-encoding scheme that will allow a neural network-based classifier to reliably distinguish between various defect classes. We will also design a decision-level fusion methodology that is able to combine different forms of evidence relating to the nature of particular defects found in ordnance.

EPILOGICS, INC.
160 C ALBRIGHT WAY
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Phone: (408) 379-5200
Topic#: 92-009 ID#: 92AVS-031
Office: AVSCOM
Contract #: NAS3-26921
PI: Frank A. Fitz
Title: High-speed Lightweight Over-running Clutch for Rotorcraft
Abstract: Current helicopters use cam locking (friction type) over-running clutches to achieve a free wheeling behavior which is necessary in their drive trains. These conventional over-running clutches tend to be rather large and heavy when designed to meet functional and flight safety requirements. Epilogics has developed a unique positive locking over-running clutch called Mechanical Diode (MD) which allows strong, light weight and extremely reliable designs with almost complete immunity to torsional vibration. One version of the over-running clutch is presently manufactured by Epilogics for automotive racing applications where strength and durability are critically important. We expect to achieve a design which will be suitable for use between a helicopter engine and drive train. This over-running clutch will provide helicopter driveline manufacturers a lighter, stronger (per unit weight), more reliable and torsionally rigid alternative to the sprag and roller ramp devices presently in use.

ESEA
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LOS ALTOS, CA 94022
Phone: (415) 962-1167
Topic#: 92-146 ID#: 92TOP-002
Office: TOP
Contract #: DACA76-93-C-0006
PI: Stanley Dallal
Title: Development of a Hierarchical Dual-function Terrain Data Set
Abstract: A hierarchical dual-function terrain data set must be designed to ensure rapid access to complex data structures, allow for frequent data modification and be compatible with existing Geographical Information System (GIS) applications. Although widely used, conventional database management systems have shortcomings in their ability to handle geographic information efficiently. An object-oriented database (OODB) design is proposed for the development of a hierarchical dual-function terrain data set. To prove the feasibility of this approach, tasks are outlined that together will develop and test a compilation strategy that will convert an existing data set into an object-based data set. In addition, the concept of providing the OODB the ability to convert itself into a format compatible with existing GIS applications is explored. The enhanced speed and flexibility of an OODB promises to find widespread use in the growing commercial and government GIS market. Data development and maintenance costs will decrease due to the increased portability and natural extensibility of the OODB in accommodating new data types such as multimedia.

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Phone: (415) 962-1167
Topic#: 92-148 ID#: 92TOP-033
Office: TOP
Contract #: DACA76-93-C-0008
PI: Warren Horowitz
Title: Feature Code Conversion Software
Abstract: Geographic Information Systems (GIS) technology is a rapidly evolving area of technology. To preserve investments made in creating existing databases, a method for automated GIS data conversion is needed. Tools for the conversion of spatial data exists, but the tools for non-spatial data conversion need further development. The overall objective of this project (Phases I and II) is the development of software to analyze, reconcile, and convert non-spatial GIS data from one scheme to another. The proposal is for the Phase I effort. The rule-base of a rule-based expert system will be developed and demonstrated. The effects of conversion between various GIS database structural architectures, and between various logical and physical formats will be analyzed. An appropriate rule set that addresses issues such as the applicability of traditional software techniques, data precision, error correction, and the reporting of data conversion quality will be created. The rule set will be demonstrated through a simplified conversion on paper. The effort will progress in three parts: information gathering, analysis, and a demonstration, which will be incorporated into the final report. Upon completion of the Phase I effort, a conceptual design of the complete system will be available.

FASTMAN, INC.
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Phone: (215) 691-2577
Topic#: 92-062 ID#: 92MIC-035
Office: MICOM
Contract #: DAAHO1-93-C-R156
PI: Dr. Michael Tucker
Title: Fractal and Wavelet Signal Processing Techniques for Radar Guided Missiles
Abstract: In this project FASTMAN will determine the feasibility of using fractal and wavelet signal preprocessing in conjunction with neural network pattern classifiers on high-range resolution radar data for detecting cold stationary ground targets in a clutter-rich environment. Previous researchers have demonstrated that measurement of the fractal dimension of high-range resolution (HRR) returns can be used to distinguish stationary targets in clutter rich environments. Other groups of researchers have shown that the Wavelet Transform can be used to accurately and efficiently measure the fractal dimensions of signals by examining the behavior of the transformed signals across scales. We propose to marry these two concepts into a signal preprocessor in which the Wavelet Transform will compute the local fractal dimensions of HRR returns, and those fractal dimensions will form a feature vector which will be used by neural network pattern classifiers to distinguish targets in the backscattered signal. We will also investigate the applicability of two other Wavelet processing techniques for radar signal processing: the use of the Adaptive Wavelet Transform to extract key target features and the use of doppler-tolerant wavelet radar pulses.

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Phone: (508) 470-1859
Topic#: 92-073 ID#: 92NAT-127
Office: NATICK
Contract #: DAAK60-93-C-0036
PI: Zvi Horovitz
Title: Fabrication Methods for Pressurized Fabric Arches
Abstract: Seamless curved high pressure beams could be produced by knitting, braiding and weaving. It was determined already that weaving is offering the best potential for resisting snow load due to the higher density and direction of the fiber alignment. Two basic types of curved tubular weaving were considered, a single shuttle flat loom and a multishuttle circular loom. After considerations, the circular loom was selected as the preferred method. The circular loom is of a very high production, and can be designed to accommodate an inner tube integrally during the weaving. The circular loom by definition working out if a creel warp, which makes it easy to weave a curved tube. A circular loom can also control the weft yarn rotation on its own axis precisely to prevent undesirable twisting of the weft if a tape shape yarn is woven.

FERMIONICS CORP.
4555 RUNWAY STREET
SIMI VALLEY, CA 93063
Topic#: 92-043 ID#: 92NV-030
Office: CECOM
Contract #: DAAB07-93-C-U010

Phone: (805) 582-0155 PI: Muren Chu
Title: Infrared Material Growth and Detector Processing Technology for Monolithic Dual-band Detectors
Abstract: Infrared detectors have wide applications in missile guidance, surveillance and smart ammunition. Within the infrared spectrum, multi-color detection is highly desirable. Among the two color detectors, the ones with multi-spectral response and sharing the common optical area are of particular interest for military applications. The goal of this program is then to develop a technology to produce two color detectors, arrays and focal plane arrays. The final FPAs to be produced by the technology developed in this program will have a monolithic structure, a common sensing area and will be on silicon wafers. The infrared material will be HgCdTe grown by MOCVD method. In this Phase I program period, HgCdTe multilayers consisting of MWIR and LWIR layers will first be produced. Subsequently, two color detectors will be fabricated in these materials by ion implementation and related processing steps. There are a number of two color detector types. By the end of this Phase I period, we will determine which type will be favored and be used in the Phase II program for producing FPAs. In the second phase of this program, multiplexers for operating two color detector arrays will be designed and fabricated. The HgCdTe two color detector arrays will be integrated to the multiplexers and then the final FPAs will be tested.

FERMIONICS CORP. Topic#: 92-118 ID#: 92ETD-040
4555 RUNWAY STREET Office: ETDL
SIMI VALLEY, CA 93063 Contract #: DAAL01-93-C-3301
Phone: (805) 582-0155 PI: Yet-Zen Liu
Title: Semiconductor Optical Amplifiers for Microwave Applications
Abstract: There are three major issues about the semiconductor amplifiers design to be addressed here: 1. that the design meets the microwave applications' requirements in term of noise, bandwidth and dynamic range, 2. that it is compatible to integration with other opto-electronic components such as detectors, waveguides and lasers, and 3. that they are compatible to integration with current and future MMIC technology. A basic waveguide structure, common to lasers, detector and waveguide, is proposed here for optical amplifiers, integratable with MMICs. By choosing a common structure these components can be readily integrated together without the need for complicated multiple growth procedures and conflicting material and process requirements. The idea centers on the principle that the property of a gain medium can be manipulated by injection of carriers to vary its gain. Similarly, for an absorbing medium by adjusting its reverse bias voltage its absorption can be varied.

FIBER GUIDE INDUSTRIES (&DIAMONEX, INC.) Topic#: 92-028 ID#: 92C3 -002
7150 WINDSOR DRIVE, SUITE #4 Office: CECOM
ALLENTOWN, PA 18106 Contract #: DAAB07-93-C-B507
Phone: (215) 366-7100 PI: Drs. B. Knapp, F. Kimock
Title: Method for Advanced Production Techniques for In-line Deposition of Diamond Scratch Resistant Coatings on Optical Glass Fibers
Abstract: The objective of the proposal is to evaluate Amorphous Diamond-Like Carbon (DLC) Coatings on Optical Glass Fibers. The principal technology implementing the coating is Diamonex's patented Ion Beam Process. Areas of Investigation include: 1. Adhesion (Diamond-like carbon to optical glass fibers); 2. Hermiticity of DLC coated fibers; 3. Tensile Strength of DLC coated fibers; 4. Thermal Stability; 5. Accelerated Aging; 6. Transmission; 7. Bending Strength; and 8. Abrasion Resistance.

FIBER MATERIALS, INC. Topic#: 92-067 ID#: 92NAT-029
5 MORIN ST. Office: NATICK
BIDDEFORD, ME 04005 Contract #: DAAK60-93-C-0015
Phone: (207) 282-5911 PI: John W. Herrick
Title: Development of Activated Carbon Fibers
Abstract: High surface area, super adsorbent activated carbon fibers are potentially an excellent adsorptive material for chemical protective uniforms. However, these fibers are not currently available from a domestic source. A Phase I program is proposed to demonstrate the feasibility of producing laboratory scale quantities of short highly activated carbon fibers based on a U.S. developed process (U.S. Patent No. 4,082,694). Carbon fibers from four precursor fibers will be obtained; pitch, PAN, phenolic resin and rayon. These fibers will be carbonized with excess potassium hydroxide at temperatures to 800-900 C,

washed and dried. The resulting fibers will possess effective BET surface areas of well over 1500M2/gram and provide excellent toxic vapor adsorption when fabricated into a flocked fabric.

FOSTER-MILLER, INC.
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Phone: (617) 890-3200
Topic#: 92-003 ID#: 92ARD-049
Office: ARDEC
Contract #: DAAA21-93-C-0037
PI: Thomas G. Campbell
Title: Advanced Material Gun Barrel
Abstract: Improvement to machine gun type automatic weapons is limited by the wear and erosion rates on current gun barrel materials. The technology exists for increasing rates of fire and muzzle velocities with new projectiles. These advanced projectiles develop significantly higher flame temperatures and bore pressures. Gun barrel erosion is accelerated by the combination of the high temperature gas erosion and the friction between the projectile and liner. Significant improvements to accuracy and lethality can be realized with improved gun barrels that withstand these advanced projectiles. The proposed program combines the experience of Saco Defense, Inc. and Foster-Millers's unique gun barrel design concept to produce a structure capable of withstanding the severe erosive environment, providing for greatly enhanced thermal conductivity both through and along the barrel axis. A ceramic liner will be used at the bore with a reinforcing carbon-carbon (C-C) sleeve. The C-C sleeve will be embedded with radial P100 graphite fibers using Foster-Miller proprietary technology. P100 fibers exhibit among the highest thermal conductivities known and will be used along the barrel axis as well. The unique properties of C-C materials to increase liner compression with temperature, because of the negative CTE, will overcome a common problem encountered with metallic sleeves. The program will entail design, fabrication, and testing of a typical liner/sleeve assembly in Phase I. The thermally induced strains, confirmed in Phase I, will form the basis of a Phase II program which will include rapid fire testing of the gun barrel.

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Phone: (617) 890-3200
Topic#: 92-004 ID#: 92ARD-050
Office: ARDEC
Contract #: DAAA21-93-C-0014
PI: Arnis Mangolds
Title: Less Than Lethal Ballistically Deployed Sting Nets
Abstract: A means of ballistically deploying a less than lethal sting net is proposed. The system developed is capable of capturing fleeing, static or attacking suspects via a LOS ensnarement munitions delivered from a 38mm weapon or a similar platform. The flight and capture principles have been proven in previous test programs and many of the subsystems have undergone initial optimization. A unique fuzing technique permits the munitions to remain in a packaged state to avoid entanglement with intermediate objects. The streamlined profile gives the munitions range capabilities exceeding current less than lethal weapons. It also results in a stable flight pattern resulting in simplified aiming. A conservative design approach has resulted in a system that is less than lethal throughout the complete 0 to 30m range. Enhancements are suggested which can extend its range and extend the demobilization of the target. By integrating an electrical discharge system into nets construction the concept evolves into a deployable electric fence or sting net. The primary challenge is the fuzing system which activates both net deployment and the High Voltage Pulse (HVP) Taser. Development procedures for investigating the munitions fuzing system is proposed.

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Phone: (617) 890-3200
Topic#: 92-027 ID#: 92BRD-080
Office: BRDEC
Contract #: DAAK70-93-C-0033
PI: Paul Chambers
Title: Infantry Fighting Position - Overhead Cover and Revetment System
Abstract: The rapidity with which reconnaissance assets can locate and identify defensive perimeters and the speed with which fire can be brought to bear on that target dictate that U.S. Army must be capable of providing its infantry and other ground forces a means of protecting their infantry fighting positions (IFP) from both direct and indirect fire in the shortest possible time after arrival at a defensive location. This protection system consists of two components, an overhead cover (OHC) for ballistic protection and a revetment system to support the walls of the IFP against blast loadings. Foster-Miller proposes to develop and

demonstrate an IFP-OHC system which will meet the IFP revetment and ballistic requirements in a standardized but tailorable kit while minimizing installation time and maximizing the protection level provided to the infantry soldier. The system is based on a composite batten and fabric revetment frame and a laminated composite sandwich OHC panel fitted with threat specific applique armor. This methodology provides requisite protection from direct (7.62 mm) and indirect fire threats (155 mm), including overpressure from point detonating and airburst artillery, as well as IFP wall collapse caused by delay fuzed artillery rounds.

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Topic#: 93-029 ID#: 93CER-003
Office: CERL
Contract #: DACA88-93-C-0022
PI: Dr. Kent G. Blizard

Title: A Reinforced Plastic Construction Material Made Entirely from Recycled Wastes

Abstract: Foster-Miller proposes to utilize commingled plastics from the municipal waste stream as matrices in reinforced construction materials. The reinforcement will consist of scrap "prepreg" such as graphite/epoxy from the industrial waste stream. By utilizing entirely recycled feedstock (both matrix and reinforcement), Foster-Miller's construction material will be both cost-effective and at the same time will address one of the major problems confronting the United States today -- lack of land fill space. Since carbon fiber is the reinforcement of choice (modulus of 200 GPa and strength of 2700 MPa), Foster-Miller's innovative recycled construction material should also overcome the mechanical property limitations of current reinforced recycled plastics. With proper interfacial control between the reinforcement and the plastic matrix, our construction material should have mechanical properties competitive with wood. A tensile strength of 75 MPa and modulus of 15 GPa are expected. This modulus is 50 to 100 percent higher than hardwood while the strengths would be comparable to fully dried hardwoods. Foster-Miller is working with a composites user who is developing alternative high value uses for scrap prepreg in order to eliminate disposal problems. By consulting with a leading researcher in the field of recycled plastics during Phase I, they will be able to maximize the pace of technical development during Phase I. To show feasibility they will compare the properties of the material to wood and demonstrate the effectiveness of the binder we choose. Practical extrusion processing conditions will also be chosen during Phase I to enable them to move quickly to full-scale development in Phase II and III.

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Topic#: 92-059 ID#: 92MIC-118
Office: MICOM
Contract #: DAAHO1-93-C-R161
PI: Dr. Lawrence H. Domash

Title: Fractal Image Sensor

Abstract: Fractal mathematical concepts are useful for modeling natural image backgrounds (foliage, clouds, sand dunes) and can help discriminate target from background in IR/thermal images on the basis of fractal dimension - particularly useful in a multiband data environment requiring sensor fusion. Similar possibilities exist for data returned from millimeter wave radar guidance. To date, however, fractal characterization of captured image data has been considered too computationally intensive for real-time response. Foster-Miller has developed a real-time "fractal image sensor" which instantaneously measures fractal dimension by using a parallel optical coprocessor based on photorefractive non-linear optics. By reducing complex image textures to a small fractal feature vector, electronic neural networks can also be applied to the coprocessor output for training on more subtle fractal characteristics. Phase I research will test the applicability of the fractal optical coprocessor to a database of typical IR/thermal imagery and also evaluate the potential for an all-electronic implementation. Phase II will construct a complete hybrid optical/electronic thermal image computer incorporating image segmentation and analysis, fractal modeling and synthesis, a dedicated fractal coprocessor for high speed characterization, and neural network training.

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Topic#: 92-070 ID#: 92NAT-098
Office: NATICK
Contract #: DAAK60-93-C-0034
PI: Hans Hug

Title: Innovative Pulse Fired Instant Hot Water Heater

Abstract: Current hot water heating is done with antiquated immersion heaters in can or in pots held over burners. Such batch

type heaters are very slow and inefficient and have no provision for filling the tank from its source of cold water, nor for supplying a pressurized flow for effective use of the hot water, unless electrical or engine driven water pumps are utilized. Foster-Miller is proposing a self powered, light weight and highly efficient resonant pulse jet burner capable of meeting the U.S. Army's requirements for a non-powered instantaneous hot water heater. It can be powered by a wide selection of liquid fuels such as gasoline, kerosene and turbine fuels. The proposed resonant pulse jet burner an extension of resonant pulse jet tubes used in insect foggers has been successfully started and tested over a temperature range from -35 F to 100 F. The instant hot water heater features a pressurized, counterflow design with built-in steam dome from which steam can be withdrawn for the operation of a piston type boiler feedwater pump. The projected design - when fully developed - will be capable of delivering approximately 35 gal/hr of pressurized hot water at an outlet temperature of 160 F. Foster-Miller's pressurized hot water heating concept can also be commercialized for applications in camping, construction, civil emergencies and in remote areas.

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Topic#: 92-071 ID#: 92NAT-119
Office: NATICK
Contract #: DAAK60-93-C-0025
PI: Robert Kovar

Title: Improved Toughness Ballistic Protective Fiber Through Molecular Modeling

Abstract: Current body armor polymer fibers are limited in ballistic performance by their tendency to lose axial tensile strength under the combined loading of lateral compression, lateral shear and axial tension that occurs during impact. This requires the use of heavier, bulkier, costlier body armor. The Foster-Miller team, which includes renowned rigid-rod polymer and molecular modeling consultants, will apply computer modeling for the first time and completely redesign the ballistic fiber to address its deficiencies. We will apply a micro-mechanical model to design rigid-rod and other specialized polymers for fibers that exhibit high tensile strength (>[illegible] gpd), high modulus (>500 gpd), higher elongation (>5 percent) and strong intermolecular inter[illegible]ion. Such fibers will show [illegible]proved ballistic performance because of higher toughness, owing to their special polymers des[illegible]n Phase I, we will [illegible]novel polymer designs that demonstrate the potential for achieving greater than 60 percent im[illegible]t in ballistic fiber [illegible]erformance against 17 grain FSPs in fabric form. In Phase II, we will refine and apply the t[illegible]g[illegible]o prepare fibers from the best polymers for complete evaluation. The principal investigator is an expert in ordered polym[illegible] design and synthesis, innovative fiber processing, advanced composites and ballistic protection.

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Topic#: 92-078 ID#: 92TAC-015
Office: TACOM
Contract #: DAAE07-93-C-R016
PI: Paul A. Chambers

Title: Mission Function Automation - AVLB

Abstract: The AVLB is a combat system employed in the assault phase of land operations to provide a means for rapid narrow gap crossing. This mission dictates that the AVLB often leads the way and hence can be subject to direct and indirect enemy fire. This fact suggests the minimization or total removal of the crew from this vehicle and the development of a remote operation system for it. The data required by the operator to ensure a successful bridge deployment is immense, including vehicle and AVLB status, vehicle location and orientation relative to the gap and gap profile. However, as the bandwidth of the operational radio fit of these vehicles precludes the use of standard video based remote control systems, a non-video based system must be developed. Foster-Miller proposes an animated graphics based remote control display system which minimizes the operator data overload possibilities by automating as many control functions as possible. This automation will minimize data flow rates and improve the efficiency of the operator in his primary role - providing a bridge for the assault forces to cross. Foster-Miller also offers an optional development of a near real-time "snapshot still video" as a means to enhance operator virtual presence at the bridging site.

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Topic#: 92-086 ID#: 92TAC-091
Office: TACOM
Contract #: DAAE07-93-C-R025
PI: John Gassner

Title: Rapid High Quality Field Repair Methods for Thick Section Composite Vehicle Structures

Abstract: Field repair methods for composite aircraft structures fail to account for the unique materials, construction and failure modes associated with thick section fiberglass composite combat vehicle structures. Although acceptable repair techniques for thick laminates have been demonstrated in the laboratory, most viable techniques require the application of heat to cure an adhesive or resin. Heating blankets, hot air, heat lamps and solar radiation are field deployable, but they all rely on heat transfer from the surface through the thick, low thermal conductivity laminate. Depending on the environment, it may take many hours to effectively cure through the thickness of the laminate. Such a lengthy procedure could severely tax field maintenance assets. In or near a combat zone, time is a life or death matter. Foster-Miller proposes a practical means to drastically reduce the time required to effect high quality field repairs. Our method would combine two proven thick laminate repair methods, resin injection and through-thickness fasteners, with an ultra-rapid, simple and safe microwave heating method. We believe that this method has the potential to reduce field repair time from many hours to less than an hour. In Phase I, we will demonstrate that a man-portable microwave hood, comprised of low cost commercially available components, can be used to rapidly and safely heat repair adhesives injected into interior delamination surfaces in a fiberglass laminate. Our team member, FMC, has agreed to provide samples at no cost to the program. In Phase II, detailed repair procedures will be developed, validated, and catalogued in a field repair handbook.

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Topic#: 92-093 ID#: 92TEC-004
Office: TECOM
Contract #: DAAD03-93-C-0001
PI: Arnis Mangolds

Title: GRID: Time-Based Seismic/Acoustic Multiple Submunition Function and Localization

Abstract: The proposed technique uses a mix of time-based acoustical and seismic information which will not only determine the functionality of the individual submunitions, as well as determine the location of their detonations. This is accomplished real-time, remotely and automatically. By optimizing the signal to noise ratios and using appropriate matched filters and sensor fusion techniques, the possibility exists for locating and determining the timing and level of detonation. The technology permits immediate feedback for optimized training and efficient acceptance testing.

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Topic#: 92-120 ID#: 92HDL-013
Office: HDL
Contract #: DAAL02-93-C-0031
PI: Dr. Parviz Tayebati

Title: Planar Integration for Nonlinear Micro-Optics

Abstract: A variety of useful optical and electro-optical elements are normally fabrication-incompatible in that they cannot be grown on the same substrate. The ability to integrate and interconnect incompatible nonlinear and linear devices would have considerable impact on a wide range of optical and optoelectronic applications. Planar micro-optics offers a unified medium provided active nonlinear semiconductor devices can be successfully integrated. Foster-Miller proposes an interdisciplinary concept combining the flexibility of alignable epitaxial lift-off (ELO) processes with the quasi 3-D Interconnectibility of quartz or sapphire based planar microoptics. The proposed program aims at integrating a number of thin film active devices including GaAs and InP bistable logic elements and switches, diffractive optical elements, and dynamic composite holograms - all currently under development at Foster-Miller - as well as commercially available devices such as semiconductor diode lasers, LEDs and detector arrays. Phase I will test the feasibility of the proposed unified detector device composed of a GaAs LED, two holographic interconnect gratings, mirror and GaAs detector on quartz substrate. Phase II research will demonstrate fully functional optical computing subsystems. Ultimate applications include optical memories, digital optics, optical interconnects, optical displays, and image processing computers.

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Topic#: 92-133 ID#: 92MTL-207
Office: MTL
Contract #: DAAL01-93-C-4036
PI: Ramki Iyer

Title: Development of Advanced NDE Sensors and Related Software for Expert Composite Manufacturing

Abstract: Advanced composite materials are finding new applications in critical components of military and commercial

equipment to exploit their synergistic properties. Therefore, it is necessary to monitor in real-time the integrity of critical composite components during the manufacturing processes. Accomplishing this task (producing high quality/reliable components) will reduce/eliminate the in-service catastrophic failures of the components. Additionally, manufacturing expenditures will be reduced due to a reduction in scrapped components and waste time and energy. Foster-Miller proposes a novel system consisting of advanced NDE sensors and related software to develop an "expert" manufacturing process. The concept employs magnetostrictive particles (sensors) embedded in a composite to detect the changes in magnetic signatures associated with the stress fields due to voids, cracks, holes, delaminations and thickness variations. Magnetic detectors can be used to monitor the magnetic signatures. In addition to the NDE sensors Foster-Miller will develop algorithms to collect, record, store and interpret the sensor signals. An "expert" system will be developed to make "expert" changes to the manufacturing process to increase product quality and reliability based on the sensor data. In summary, the Army will have developed an advanced technique to improve the quality and reliability of critical equipment such as composite gun barrels now under investigation; composite armor and outer skins on tanks and personnel carriers; and composite rotor blades on helicopters. Additionally, the Army will realize a savings on equipment acquisition due to reduced manufacturing costs.

GENERAL ATRONICS CORP.
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Phone: (215) 233-4100
Topic#: 92-026 ID#: 92BRD-096
Office: BRDEC
Contract #: DAAK70-93-C-0030
PI: Thomas W. Jewitt
Title: Intrusion Detection From a Moving Platform
Abstract: Automatic Target Recognition (ATR) broadly refers to the problems of target detection, acquisition/tracking. The processing is completely autonomous in extracting the necessary information from sensor inputs, in processing, and final decision-making. In addition to the traditional military applications, ATR algorithms can be adopted to endow a mobile sentry robot with the capability to detect intruder generated phenomena. Monocular parallax extracted by tracking objects viewed from a mobile CCD camera is converted to three-dimensional (3-D) position estimates. Simulations have demonstrated that (l) the resolution and accuracy at which a robot can sample its environment using a mobile CCD camera is significantly greater than that achieved using sonar; (2) by comparing perceived angular motion of objects in its environment with that expected of stationary objects, the robot can detect body movement of an intruder while on the move, and (3) 3-D position estimates of objects in the robot's environment can be exploited for autonomous navigation, obstacle avoidance, and map generation. It is proposed that the aforementioned capability be complemented with processing and hardware subsystems which detect different types of intruder generated phenomena as follows: By comparing the 3-D position of objects as determined on the first patrol with that of objects as determined on subsequent patrols, the robot can detect a stationary intruder or disappearance of possessions. Also, microphones would allow the robot to detect an intruder which it can "hear" not "see."

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Phone: (201) 663-5980
Topic#: 92-002 ID#: 92ARD-044
Office: ARDEC
Contract #: DAAA21-93-C-0018
PI: Gerald Doyle
Title: Formulations with Enhanced Energetic Output
Abstract: 1,3,3-Trinitroazetidine (TNAZ) has emerged as an important new energetic material for warheads, main explosive fill in bombs, and as an ingredient in LOVA propellants. Initial testing has shown its detonation performance is superior to that of HMX, outperforming the calculational prediction. With good performance, thermal compatibility and sensitivity characteristics, coupled to the ability to formulate and process TNAZ, this material can be exploited in a broad spectrum of applications. The proposed effort will establish formulation and processing parameters and bring into focus performance aspects for TNAZ-based press-loadable explosives. Formulations that are 100% HE fill, such as binderless TNAZ/NTO, may result in additional energetic output due to overdriving the NTO fill when the TNAZ matrix undergoes detonation. Any formulations investigated during this study can easily be scaled-up and submitted for large-scale performance testing.

GLYNN SCIENTIFIC, INC.
73 FRANKLIN ST.
ANNAPOLIS, MD 21401
Topic#: 93-001 ID#: 93ARD-044
Office: ARDEC
Contract #: DAAA21-93-C-0079

Phone: (410) 268-6981 PI: Thomas Fullerton
Title: Smart Mortar Guidance
Abstract: This proposal details an approach to providing mortar munitions with increased effectiveness via use of a dual purpose millimeter wave terminal guidance seeker. The concept seeker uses an active-mode millimeter wave radar sensor to effect target detection and target tracking functions. Additionally, a target designator-cued mode of operation has been conceptualized for engagement of armored vehicles and especially high value targets. In the primary mode of operation, the seeker is an autonomous millimeter wave radar that is capable of carrying out target search, detection, and tracking operations through use of multi-level algorithms coded into the signal processor. In the secondary mode of operation, the seeker is cued by a low probability of intercept millimeter wave illuminator operated by a forward observer.

GUIDED SYSTEMS TECHNOLOGIES Topic#: 92-007 ID#: 92AVS-015
430 TENTH STREET, NW, SUITE S-002 Office: AVSCOM
ATLANTA, GA 30318 Contract #: NAS1-19981
Phone: (404) 873-3493 PI: J. Eric Corban
Title: Intelligent Nonlinear Control of Remotely Piloted Model Scale Helicopters
Abstract: An intelligent nonlinear control methodology, based on an innovative combination of feedback linearization and artificial neural networks, is to be adapted to control remotely piloted helicopters. A mapping is derived which transforms a non-linear dynamic model of the plant into a linear, time invariant space. A single point linear controller design is then carried out in this linear space. The derived control is then mapped back into the nonlinear space using an inverse transformation. An artificial neural network can be trained prior to flight to realize the inverse mapping in real time. A second network can be trained in flight to learn, and correct for, the vehicle characteristics not captured in the dynamic model used to derive the control. The feasibility and value of this approach is to be demonstrated by evaluation of a controller design for the current US Army/NASA X-Cell model-scale helicopter using a high fidelity dynamic simulation. The design will include optional position feedback loops which can be used to track a prescribed trajectory. Once the computational burden of the control algorithm has been quantified, conceptual design of flight worthy hardware will begin. Detailed design, construction, test and evaluation will be carried out in Phase II.

GUMBS ASSOC., INC. Topic#: 92-068 ID#: 92NAT-037
11 HARTS LANE Office: NATICK
EAST BRUNSWICK, NJ 08816 Contract #: DAAK60-93-C-0008
Phone: (908) 257-9049 PI: Dr. Ronald W. Gumbs
Title: Flexible EMI Shielding Materials Using Conducting Copolymers
Abstract: There is a need for flexible EMI shielding material in the construction of tactical shelters. This proposal outlines a program to develop such a material using wire mesh or knitted wire mesh sandwiched between two sheets of an electrically conducting copolymer which is elastomeric in nature. The proposed material will maintain its flexibility so that when flexed a number of times, it will not fracture or lose its initial effectiveness. It is also anticipated that the material will be rugged and durable. The proposed work relies on prior experience at Gumbs specifically in the use of conducting polymers for EMI shielding composites and encapsulants. During Phase I, prototypes will be fabricated and tested in efforts to demonstrate feasibility of the concept. Larger panels will be prepared during Phase II to conduct full scale performance and evaluation tests.

HARRIS TECHNOLOGIES, INC. Topic#: 92-096 ID#: 92STR-006
6636 TANSEY DRIVE Office: STRICOM
FALLS CHURCH, VA 22042 Contract #: M67004-93-C-0036
Phone: (703) 255-9456 PI: James C. Harris, Phd
Title: Application of Info-geometric Instrumentation for the Interactive "Virtual" Integration of Large Scale Battlefield & TES Combined Armed Forces
Abstract: Research associated with this Phase I Small Business Innovative Research proposal, and its possible Phase II follow-on, are expected to demonstrate the feasibility and practicality of use of affordable info-geometric instrumentation technology for accurately integrating real and virtual forces, crews and advanced weapons systems in combined laboratory (trainer) and field (operational maneuvering) tactical engagement simulations. In addition, the potential will be demonstrated for info-geometric

field/trainer instrumentation to support human factors experiments and crew performance evaluation/modeling. Two powerful info-geometric (IG) approaches to be employed in the subject research are the SESCO, Inc. "Smart Weapon Adjustable Aspect and Ranging Microinterceptor" (SW&RM) and the Info-Geometrics, Inc. "Organic Self-organizing Information- and Range-based IFF System" (OSIRIS). The two complementary, proprietary, info-geometric technologies can be employed in common, low cost 'open architecture' hardware. Harris Technologies, Inc. holds application licenses for both patent-pending technologies. The proposed six month Phase I research consists of a two month application requirements analysis task - including attendance at one or more Simulations Standards Compatibility Workshops, followed by an additional two month info-geometric instrumentations application system architecture definition phase. Application requirements analyses would include consideration of such PM-TRADE future application technology requirements as those associated with Battlefield Distributed Simulator Development (BDSD) and Mobile Automated Instrumentation Suite (MAIS). The final report, which will be submitted in the fifth month, will analyze expected technical merits and cost benefits to be derived from an application of the proposed research, together with the definition of an eight-to-ten month SBIR Phase II info-geometric instrumentation system feasibility demonstration.

HITTITE MICROWAVE CORP.
21 CABOT ROAD
WOBURN, MA 01801
Phone: (617) 933-7267

Topic#: 93-002 ID#: 93ARD-017
Office: ARDEC
Contract #: DAAA21-93-C-0080
PI: Peter Katzin

Title: Sub-munitions with Identification Friend or Foe Capability

Abstract: To prevent fratercides in today's congested battlefield, there is a critical need for positive methods of identifying friend-or-foe. The Army initiative for the Battlefield Combat Identification System (BCIS) addresses the need for pre-launch IFF. With deployment of smart munitions and long-range guns, there is an increasing need to provide post-launch IFF capabilities on-board munitions. This proposal describes an advanced concept of identifying co-operative targets capable of both pre-launch and post-launch applications. The proposed concept is based on the use of low-cost miniature microwave transponder (i.e. ID tag) that can be interrogated from the firing position and/or from munitions in flight. Both the transponder and the interrogator will be build in MMIC chips for low cost and small size. The proposed interrogation and response system, with electronically programmed encryption, is immune to jamming, decoding, or false target detection. The interrogator function on munitions may be built into a transmitter available on board. The interrogator may be integrated with the proximity fuze available on board. The interrogator may be integrated with the proximity fuze transmitter, for example, for pre-fuzing or dudding when a friendly target is detected. The transponder, built in a miniature package using MMIC chips, can be hand-carried or mounted on any combat vehicle.

HITTITE MICROWAVE CORP.
21 CABOT ROAD
WOBURN, MA 01801
Phone: (617) 933-7267

Topic#: 93-015 ID#: 93MIC-123
Office: MICOM
Contract #: DAAH01-93-C-R337
PI: Mitchell Shifrin

Title: Linear Microwave Attenuator

Abstract: For signal level control in microwave systems, attenuators are normally designed to improve logarithmic level variation (i.e. in dBs) in response to a control signal. For some level control applications, the logarithmic control is inadequate to provide the fine resolution needed at low attenuation levels. Examples of such requirements include: weighted loading of antenna arrays, alignment of mono-pulse receivers, antenna nulling, and digital modulation (e.g. QAM) for communications. In most of these applications, it is highly desirable to have independent means of control for amplitude and phase. This proposal describes several alternate circuit designs to attain the attenuation/level control requirements, and outlines an approach to select the optimum design for MMIC implementation. Design options include: active gain controlled amplifiers vs. attenuators, and digital vs. analog control of attenuation/gain. Methods of phase compensation and linearization, applicable to various design options, are also presented to show that the level control function can be accomplished with negligible phase variations. Hittite proposes to implement an MMIC design of the attenuator/level control circuit. The MMIC design will lead to miniaturization and provide the flexibility of integrating additional microwave circuit functions on-chip with the attenuator. Hittite also proposes a laboratory demonstration of the selected approach using available assets.

HITTITE MICROWAVE CORP.
21 CABOT RD
WOBURN, MA 01801
Phone: (617) 933-7267
Topic#: 92-126 ID#: 92HDL-078
Office: HDL
Contract #: DAAL02-93-C-0018
PI: Leonard Reynolds
Title: Low Power Monolithic Microwave Integrated Circuits
Abstract: In Phase I of DARP MIMIC program, Hittite Microwave Corporation, in co-operation with Harry Diamond Laboratories, has developed a GaAs MMIC chip which performs complete RF functions of an FM-CW radar designed for proximity fuze applications in Army's Multi-Option Fuze for Artillery (MOFA). The RF package for this fuze is a miniature IC package measuring .25" x .25" x .09". The RF assembly integrated with a single-patch antenna is about the size of a five-cent coin. This MMIC radar consumes .9 to 1.25 watts of DC power. In Phase 2 of the MIMIC program, Hittite has a task of developing a smaller and lower-cost chip which consumes much less DC power for fuzing applications in small munitions. MMIC processes based on enhancement/depletion-mode MESFET and hetero-junction bipolar transistor (HBT) devices are becoming available as stabilized production processes. These new device technologies will be utilized to develop lower cost, less power hungry radar MMIC with added performance capabilities. In addition to the basic radar function, the new radar chips to be developed in this program will incorporate ECM-resistance and HPM protection capabilities. The MMIC functions to be developed for these added capabilities are: advanced modulation and demodulation circuits and self-activated switch/attenuator used as a limiter. The proposed Phase I study will lead to design, simulation, performance analysis, and preliminary layout of the low-cost, low-power MMIC radar chip with added jam/burn-out resistance capabilities.

HNC, INC.
5501 OBERLIN DRIVE
SAN DIEGO, CA 92121
Phone: (619) 546-8877
Topic#: 92-054 ID#: 92MIC-025
Office: MICOM
Contract #: DAAHO1-93-C-R137
PI: Robert Hecht-Nielsen
Title: Mobius Compression
Abstract: In 1827 mathematician August Mobius introduced a predecessor to linear algebra which he called the barycentric calculus. In Mobius scheme, an arbitrary vector x in n-dimensional Euclidean space is expressed as the center of mass (or barycenter) of N point masses located at positions w1, w2,...,wN, and having masses m1, m2,...,mN, respectively (i.e., x = summation of (mk)(wk) from k = 1 to N, where the summation of (mk) = 1 from k = 1 to N. In this project we shall explore the use of an adaptive neural network technique for selecting nearly orthogonal point mass positions embedded within a statistical population of data block vectors to dramatically improve the performance of vector quantization data compression systems for communications. The idea is to transmit not only the nearest matching codebook vector, but a small set of qualified codebook vectors and their corresponding masses. In this way the original data vector can be accurately reconstructed as the barycenter of these masses with much less error and much higher compression than fixed transform (e.g., JPEG), vector quantization, eigenimage, and principal component analysis approaches. A modest computational burden and real-time operation are inherent in the method, unlike fractal compression. The goal of Phase I will be to demonstrate 40:1 compression of video images with an RMS pixel value distortion of less than 10% in the decompressed imagery. In Phase II, the goal will be 100:1 compression with an RMS error level below 5%.

HORIZONS TECHNOLOGY, INC.
3990 RUFFIN ROAD
SAN DIEGO, CA 92123
Phone: (619) 292-8331
Topic#: 92-087 ID#: 92TAC-115
Office: TACOM
Contract #: DAAE07-93-C-R027
PI: James N. Treadwell
Title: Electronic Map Display and Route Planner (EMD/RP)
Abstract: Several of today's emerging and developed technologies lend themselves to an innovative engineering solution to the challenges of battlefield situational awareness, automated route planning, navigation, and coordination for combat vehicles on the modern battlefield. HTI proposes to integrate these technologies in the development of an Electronic Map Display and Route Planner (EMD/RP). The Phase I effort will focus on the various individual technologies as well as their integration for a fully functional EMD/RP application. The specific technologies include: Geographic Information System (GIS) software; GIS databases; flat-panel displays; autorouting algorithms; Global Positioning System (GPS); and tactical communication systems, such as the Position Locating and Reporting System (PLARS). Each of these critical technologies represents a facet of a production EMD/RP. The intent is to pursue an integrated system architecture taking advantage to the greatest extent possible

of existing technologies tailored for the EMD/PR application.

HUNTINGTON RESEARCH AND ENGINEERING
P.O. BOX 90118
SAN JOSE, CA 95109
Phone: (408) 293-9425
Topic#: 92-172 ID#: 92SDC-030
Office: SDC
Contract #: DASG60-93-C-0008
PI: John H. Huntington
Title: Machete Kill Device for Kinetic Energy ASAT Weapon System
Abstract: Intelligent Reasoning Systems (IRS) is developing an integrated active vision system (AVS) based on design principles derived from experimental analysis of mammalian visual systems. The AVS design is based on a asynchronous analog encoding of location and motion data, and a custom VLSI Hybrid Temporal Processing Element (HTPE) developed by and available solely to IRS (patent pending). The HTPE can operate on analog data at frequencies in excess of 100 MHz, allowing rapid oversampling methods to be used for resolution enhancement, motion detection, and multiple-template matching. HTPEs have low device count and power dissipation, and can be fabricated in small layout areas. The AVS is intended for eventual on-board application in robots, intelligent machine tools, and other autonomous sensory-motor systems that require visible, IR, or similar input. The initial step in visual processing is the collection of data from the primary sensor. The goal of this Phase I proposal is to evaluate the feasibility of a silicon retina for the AVS based on the HTPE, and to investigate various methods for achieving sub-pixel resolution and enhanced motion sensitivity with such a retina.

HYGEIA PHARMACEUTICALS, INC.
6555 NANCY RIDGE DR., #300
SAN DIEGO, CA 92121
Phone: (619) 453-9393
Topic#: 92-162 ID#: 92MED-022
Office: MEDICAL
Contract #: DAMD17-93-C-3083
PI: Mark C. Glassy, Ph.D.
Title: Neutralizing Monoclonal Antibodies Against Biological Toxins
Abstract: No specific treatment regime exists for a large number of biological toxins. These toxins pose a threat in a military context and also constitute a public health hazard, mainly when accidentally ingested. An important class of biological toxins are those which inhibit protein synthesis, found in plants as well as bacteria. Many of these share structural and mechanistic properties. They are proteins, often of about 60,000 MW, with two subunits, one responsible for binding to cells, the other for the toxic action. The most common targets of these toxins are in ribosome and the most toxic of the substances kill at one molecule per cell. Hygeia Pharmaceuticals develops human monoclonal antibodies for use as therapeutic agents. For this study, we will use ricin as a model system to demonstrate neutralizing specificity. We will perform an in vitro immunization and then fuse resulting lymphocytes with a proprietary human fusion partner. Resulting hybridomas will be cloned and assayed for antigen recognition and for the neutralization of ricin in model systems.

I SIGHT, INC.
40 RAMLAND ROAD SOUTH, SUITE 18
ORANGEBURG, CA 10962
Phone: (914) 359-4500
Topic#: 93-018 ID#: 93MIC-084
Office: MICOM
Contract #: DAAHO1-93-C-R260
PI: Gerald B. Lichtenberger
Title: Large Dynamic Range Camera
Abstract: Adaptive Sensitivity(TM), developed by I Sight Inc., overcomes the chronic problem of limited dynamic range in existing video cameras. In I Sight's cameras, a dynamic range in excess of 50,000:1 is accomplished by sequentially acquiring, with a single CCD, two images spanning two separate ranges of light intensity. The two images are combined by a neighborhood processing algorithm into a single image which spans the wide intrascene dynamic range. The resulting full motion video image is then compressed to a dynamic range of 1:256, displayable on standard CRTs. In this project, we will develop a camera with a dynamic range greater than 50,000:1 and video rate of 60 FPS, by simultaneously acquiring two frames with two CCDs, which span the required intrascene dynamic range. These CCDs will be "boresighted", i.e., superimposed on the optical axis through a beamsplitter. Current system electronics will be modified to manage the two CCDs. Phase I will result in an optical bench prototype, operating at standard video rates (30 FPS). Phase II will result in a packaged system functioning at higher rates (60 FPS). The proposed development will combine the advantages offered by Adaptive Sensitivity(TM) with the requirements of a high frame rate system.

I-MATH ASSOC., INC.
P.O. BOX 560788
ORLANDO, FL 32856
Phone: (407) 857-3213
Topic#: 92-042 ID#: 92NV-009
Office: CECOM
Contract #: DAAB07-93-C-U006
PI: Alexander Akerman III
Title: FLIR & MMW Algorithms to Detect and Classify Stationary Targets
Abstract: Six multisensory (FLIR/MMW) data bases will be accessed to include all those at CNVEOD including the VISION 1 and subsequent field tests, particularly those involving the RIMS and BWI MMW radars, along with the IIDAS and SAIRS FLIRS. Data from other government agencies will include that in TABILS and at HDL, MICOM, and AATD. A Phase II plan will be produced for training and testing three ATR algorithms not heretofore considered for tank-mounted applications but proven in related contexts: 1. An adaptive Bayesian statistical classifier, which in its operational implementation would be continually retrained upon the actual ground clutter within which the tank is operating. 2. A "genetic" algorithm, which uses the same feature sets as #1, but evolves a different polynomial discriminant function. Both the "genetic" and "adaptive" classifier algorithms are under development for the LONGBOW MMW radar by Systems Dynamics, who would be subcontracted to I-MATH for this SBIR. 3. Geometric hashing algorithms, which I-MATH has recently developed using a CNVEOD-provided FLIR imagery under a Phase II Air Force SBIR. Such algorithms provide a robust mechanism for multisensor fusion as well, since each feature is indexed by its geometric position. This greatly facilitates the incorporation of MMW range (z) profiles as a third coordinate to FLIR (x,y) has points.

INDUSTRIAL EVOLUTION
P.O. BOX 2570
KENNEBUNKPORT, ME 04046
Phone: (207) 967-8807
Topic#: 92-065 ID#: 92NAT-002
Office: NATICK
Contract #: DAAK60-93-C-0042
PI: Alan J. Zauzmer
Title: Individual Combat Soldier Identification Technology
Abstract: The proposal offers a technology/concept to allow individual combat soldiers and components of the Electronic Battlefield System a means of identifying friendly forces.

INDUSTRIAL HONEYCOMB STRUCTURES, INC.
3200 W. 71ST AVE., #14
WESTMINSTER, CO 80030
Phone: (303) 722-8258
Topic#: 92-027 ID#: 92BRD-084
Office: BRDEC
Contract #: DAAK70-93-C-0031
PI: Jerry D. Plunkett, PhD
Title: A Fiberglass/Kevlar-reinforced-polymer Honeycomb Panel Concept for an OHC-IFP.
Abstract: As a candidate OHC-IFP panel concept, Industrial Honeycomb Structures, Inc. proposes an innovative fiber-reinforced-polymer honeycomb core material sandwiched between two fiber-reinforced-polymer skins. These materials are light weight, high strength, tough, resilient, and highly producible, but need to be qualified for ballistic protection. The honeycomb cores appear promising as a means for limiting localized damage by ballistic impact. We propose to design, test, adjust the design, and further test 20 panels, by subjecting them to impacts at short-range, normal incidence of 7.62 mm ball ammunition. The front and back skins of the sandwich construction will be comprised of fiberglass- and/or Kevlar-reinforced woven fiber mats.embedded in polymer. Based on initial testing results, the relative amounts of these reinforcements will be adjusted, and 20 panels will be designed and delivered as prototypes for further testing.

INDUSTRIAL HONEYCOMB STRUCTURES, INC.
3200 W. 71ST AVE., #14
WESTMINSTER, CO 80030
Phone: (303) 722-8258
Topic#: 93-029 ID#: 93CER-029
Office: CERL
Contract #: DACA88-93-C-0016
PI: Jerry D. Plunkett, Ph.D.
Title: Manufacturing Fiber-reinforced-polymer Honeycomb (FRPH) Structural Systems Incorporating Recycled Plastics
Abstract: As a candidate concept to recycle post-consumer waste (PCW), Industrial Honeycomb Structures, Inc. (IHS) proposes to incorporate PCWs as feedstocks for manufacturing an innovative, cost-effective construction material systems using building panels comprised of paper-honeycomb and fiber-reinforced-polymer honeycomb (FRPH) structural elements. These elements are light-weight, high-strength, tough, resilient, and capable of high-volume machine fabrication. Nine candidate panel applications are proposed, each of which would incorporate large quantities of PCWs. The PCWs would replace virgin materials

that would otherwise be used in manufacturing the structural panels. During the Phase I project, feasibility for five selected FRPH panel applications will be determined through the following steps: develop design specifications, design panel, fabricate test specimens, perform laboratory tests, and evaluate the test results.

INDUSTRIAL QUALITY, INC.
19634 CLUB HOUSE ROAD
GAITHERSBURG, MD 20879
Phone: (301) 948-2460
Topic#: 92-095 ID#: 92TEC-026
Office: TECOM
Contract #: DAAD01-93-C-0050
PI: Harold Berger
Title: High Energy X-ray Stereo-radioscopic System
Abstract: The proposed Phase I program will result in a demonstration of three-dimensional imaging with images taken with the existing high energy x-ray inspection systems at the U.S. Army Yuma Proving Ground. These images will be processed so they can be presented as prompt-response stereo television images. In addition, the capability to measure defect dimensions using a cursor-prompted software program will be evaluated. The modifications that will be needed to make the Yuma x-ray inspection system into one with stereo/three dimensional capability will be determined so that those modifications can proceed in a Phase II program. This realistic program is proposed by a small, high technology company with broad experience in x-ray imaging and with specific prior experience with a stereo, real-time microradiographic imaging system. Differences described here include high energy x-ray inspection, additional image processing to reduce image unsharpness, probable object rotation instead of electronic source movement to generate stereo views, near real-time imaging capability and system modification instead of a complete stereo system.

INNOTECH INTERNATIONAL, INC.
5437 JO PASS
E. LANSING, MI 48823
Phone: (517) 249-2375
Topic#: 93-029 ID#: 93CER-015
Office: CERL
Contract #: DACA88-93-C-0019
PI: Al Sari
Title: Depolymerization of Post-Consumer PET Waste to Produce Polymer Concrete for Rehabilitation Applications
Abstract: The goal of the proposed research is to recycle PET and eventually other plastic wastes, through depolymerization while avoiding costly purification and color-removal steps, into low-cost and highly durable rapid-setting rehabilitation materials. Successful implementation of the proposed technology will impact two critical issues of our time - infrastructure and the environment - through recycling of some prominent plastic wastes into cost-effective rehabilitation materials with desirable performance characteristics. Phase I research evaluates the technical feasibility and economical viability of developing polymer concrete rehabilitation materials through depolymerizing impure and color post-consumer PET wastes. For this purpose, PET scrap sources and depolymerization process capable of generating unsaturated polyesters with acceptable processability and clear-cast resin characteristics will be identified. Optimum composition of polymer concretes incorporating recycled polyester binder will then be determined based on set characteristics, short-term engineering properties, and cost. Finally, market potentials of recycled polyester concrete will be determined through technical and economical evaluations against conventional rapid-setting rehabilitation materials.

INNOVATIVE DYNAMICS, INC.
CORNELL RESEARCH PARK, LANGMUIR LABS, 95 BROWN RD
ITHACA, NY 14850
Phone: (607) 257-0533
Topic#: 92-143 ID#: 92CER-025
Office: CERL
Contract #: DACA88-93-C-0004
PI: Bruce W. McKee
Title: Automated In-situ Inspection System for Underground Fuel Storage Tanks
Abstract: Currently, no commercial robotic inspection system can operate in a petrochemical bath and perform the precise, repeatable measurements required for tank inspection. Innovative Dynamics proposes to address this problem by determining the sensor requirements for robotic tank inspection. An integrated sensor module will be developed containing an ultrasonic wall thickness gage, a video inspection sensor, and a capacitance-based corrosion/crack sensor, the latter adapted from previous NDE sensor work at IDI. The combined sensor measurements will maximize the probability of detecting tank wall and tank liner defects. An evaluation of systems for registering measurements on the tank wall will be performed to enable precise and repeatable measurements. Automated fault diagnosis will be provided using a neural-network-based expert system. Lab tests on submerged tank wall specimens will be performed to evaluate the sensor module performance. Based on these sensor studies,

deployment requirements will be defined during Phase II for the design and fabrication of an operational robotic inspection system. Cost effective solutions will be sought. Custom or modified commercially available robot types, such as the underwater remotely operated vehicles or magnetically-attached surface crawler, will be evaluated which will fulfill these requirements.

INRAD, INC.
181 LEGRAND AVE
NORTHVALE, NJ 07647
Phone: (201) 767-1910
Topic#: 92-100 ID#: 92ARO-023
Office: ARO
Contract #: DAAH04-93-C-0008
PI: Dr. Zhenyu Zhang
Title: Low Temperature Templated Synthesis of Fullerenes
Abstract: Fullerenes form a series of new allotropes of carbon that have a myriad of unusual properties. Fullerene research has seen explosive growth since 1990 when C60 was isolated from carbon soot. However, the prohibitively high price of pure C60 ($2000/g) is a major obstacle to fullerene research and certainly for commercial applications. These high costs are due to the low yields obtained using current technology. We propose to develop superior methods for synthesizing and purifying fullerenes with the goal of dramatically reducing the cost for pure fullerenes. We will control fullerene growth to achieve high yields of small and mid-size, solvent-extractable fullerenes by minimizing the formation of soot, giant fullerenes, and buckytubes. In addition to eliminating the formation of undesirable side products, we expect to carry out the conversions at significantly lower temperatures and to direct the formation of other fullerene materials, which are not currently available commercially. The efficient synthesis, isolation, and purification of fullerenes would greatly reduce production costs, thereby further stimulating fullerene research and helping to make potential commercial applications for fullerenes a reality.

INTELLIGENT AUTOMATION, INC.
1370 PICCARD DRIVE, SUITE 210
ROCKVILLE, MD 20850
Phone: (301) 990-2407
Topic#: 92-026 ID#: 92BRD-101
Office: BRDEC
Contract #: DAAK70-93-C-0028
PI: Leonard S. Haynes
Title: Intrusion Detection Using Fast 3D Imaging
Abstract: The problem described in the RFP is to build a system which will be able to detect intrusion from a moving platform. The solution herein proposed is based on a new type of camera designed by Intelligent Automation, Incorporated. This new type of camera produces a three dimensional image of the scene at normal video frame rates of 60 frames per second. Our Fast 3D Imaging camera will generate 3 dimensional images in real time. By "3 Dimensional Image" we mean that the value of each pixel in the image will represent the distance from the camera's focal point to the corresponding point in the scene. We call this type of image a range image. Our intrusion detection approach uses the range camera for what is basically visual inspection. A conventional videotape would be made of the vehicle's patrol path where the videotape would be recording the range image from the range camera (not a normal intensity image). This can be thought of as the "teach mode", where both the path and the expected range recording is captured at normal frame rates. Then as the vehicle moves through its normal patrol path, it continually compares its real-time range image with the pre-recorded "normal" range image. Minor differences are used to control the vehicle along the pre-defined path. Significant deviations must be caused by unexpected changes in the area and would raise an alarm. The same range camera Output can also be used for obstacle avoidance. Our Fast 3D Imaging camera can also capture normal intensity images by switching the state of a single control bit. The range image and the intensity image can therefore be used without requiring an additional camera.

INTELLIGENT REASONING SYSTEMS
647 CREED AVE
LAS CRUCES, NM 88005
Phone: (505) 527-1317
Topic#: 92-172 ID#: 92SDC-036
Office: SDC
Contract #: DASG60-93-C-0004
PI: Mark R. DeYoun
Title: Resolution and Motion-Detection Enhancement Using an Oscillating Saccadi Perception System
Abstract: Intelligent Reasoning Systems (IRS) is developing an integrated active vision system (AVS) based on design principles derived from experimental analysis of mammalian visual systems. The AVS design is based on a asynchronous analog encoding of location and motion data, and a custom VLSI Hybrid Temporal Processing Element (HTPE) developed by and available solely to IRS (patent pending). The HPTE can operate on analog data at frequencies in excess of 100 MHz, allowing rapid oversampling methods to be used for resolution enhancement, motion detection, and multiple-template matching. HTPEs have

(531)

low device count and power dissipation, and can be fabricated in small layout areas. The AVS is intended for eventual on-board application in robots, intelligent machine tools, and other autonomous sensory-motor systems that require visible, IR, or similar input. The initial step in visual processing is the collection of data from the primary sensor. The goal of this Phase I proposal is to evaluate the feasibility of a silicon retina for the AVS based on the HTPE,and to investigate various methods for achieving sub-pixel resolution and enhance motion sensitivity with such a retina.

INTERFACE TECHNOLOGIES
4251 SEA PINES COURT
CAPITOLA, CA 95010
Phone: (408) 475-8143

Topic#: 92-098 ID#: 92STR-015
Office: STRICOM
Contract #: M67004-93-C-0038
PI: Kenneth Nemire, Ph.D.

Title: An Immersive Virtual Prototyping Environment for the Design of Advanced Weapons System in the Battlefield Distributed Simulation Environment

Abstract: Design of advanced weapons in the Battlefield Distributed Simulation environment requires construction and evaluation of physical prototypes before final production of the system. Faster, more efficient means of iterative construction and modification of weapon system prototypes may be accomplished in virtual, rather than physical environments. The current virtual prototyping technology may be improved by constructing an immersive virtual environment (VE) in which the designer sees the visual and spatial characteristics of the system in a head-coupled display and interacts with the environment with instrumented gloves allowing natural manipulations and gestures, and providing tactile and force stimulation representing interactions with the VE. Addition of a virtual auditory environment may enhance the kinesthetic experience. Current limitations of the hardware used in VE systems may adversely influence prototyping performance. We will conduct design task analyses and interactive experimentation to determine which combination of VE system components will provide the best VE for the designer. The research is also important for determining the fidelity of the VE system necessary for optimal performance. The research and development team has extensive experience in creating rapid prototyping tools, designing and developing virtual environments and crewstations, and conducting experimental and human factors research; it should prove to be a productive team.

INTERSCIENCE, INC.
105 JORDAN RD
TROY, NY 12180
Phone: (518) 283-7500

Topic#: 92-129 ID#: 92HDL-090
Office: HDL
Contract #: DAAL02-93-C-0035
PI: Eduardo Saravia

Title: High Sensitivity Wideband Analog Fiber-optic Link Based on Integrated Optical Modulator

Abstract: The development of an analog optical link capable of transmitting measured currents and voltages from anechoic chambers to remote control and data acquisition systems is proposed. The system is based on integrated optical modulator (IOM) coupled to a cw 1.3 mm diode laser and to a high frequency PIN diode photodetector. The main advantage of the external modulation of a laser light, is that modulating frequencies as high as 15 GHz can be very attractive for the proposed application. Recent advantages in the fabrication of these modulators, based on an Annealed Proton Exchange process, have produced IOMs that are extremely stable for high optical power of a few hundred of milliwatts. A prototype unit will be developed and fully tested under the Phase I effort to demonstrate the functional capabilities of the proposed concept.

ITERATED SYSTEMS, INC.
5550 PEACHTREE PARKWAY
NORCROSS, GA 30092
Phone: (404) 840-0728

Topic#: 92-054 ID#: 92MIC-048
Office: MICOM
Contract #: DAAHO1-93-C-R129
PI: Alan Sloan

Title: Real Time Fractal Image Compression Techniques

Abstract: The objective of this proposal is to demonstrate the feasibility of a new NA resolution independent digital image compression technology in the area of real time compression for imagery including types generated by electro-optical, imaging infrared and millimeter wave sensors. The technology is based on Fractal Transform technology. Digital imagery is generated at a high rate and needs to be distributed over communication links of varying bandwidth. The nature of video is evolving as sensors, training systems and displays require ever higher resolutions. High compression rates and resolution independence are needed to accommodate the varying bandwidths and evolving requirements. Image data representative of the products of Army

sensors will be identified and obtained. This data will be digitized and then processed using Fractal Transform technology to obtain a compressed representation of the Army sensor imagery. A real-time test of expansion and display of imagery representative of that produced from Army type sensors will be conducted. The final report will describe the results of this test. Configurations to achieve real time compression will be evaluated and described in the final report.

J.K. RESEARCH
210 SOUTH WALLACE
BOZEMAN, MT 59715
Phone: (406) 586-8744

Topic#: 92-046 ID#: 92CRD-001
Office: CRDEC
Contract #: DAAA15-93-C-0017
PI: Dr. Joan Combie

Title: Heat Stable Alkaline Phosphatase from Thermophiles

Abstract: Enzymes used as the label for most non-radioactive assays and in biosensors, are the most unstable component of these systems. As immunoassays and biosensors move from the tightly controlled laboratory environment to demanding field conditions, the need for a more stable enzyme becomes critical. Alkaline phosphatase is the most widely used enzyme for these types of applications. A heat stable enzyme would not only allow use over a range of temperatures but would also increase the shelf life of these detection systems. Alkaline phosphatase is currently obtained from mammalian sources and is not stable at elevated temperatures. Thermophilic microorganisms producing heat stable alkaline phosphatase have been isolated by J. K. Research. The objective of this proposed research is to select a thermophile producing heat stable alkaline phosphatase and characterize the enzyme. Media will be developed to enhance enzyme production. A purification scheme will be optimized for maximum recovery of purified alkaline phosphatase. Sufficient heat stable enzyme will be produced to determine kinetic parameters and the most suitable reaction conditions.

KARS' ADVANCED MATERIALS, INC.
7271 GARDEN GROVE BLVD, SUITES C & D
GARDEN GROVE, CA 92641
Phone: (714) 892-8987

Topic#: 92-106 ID#: 92BRL-010
Office: BRL
Contract #: 93C-0081
PI: Dr. Ramesh J. Kar

Title: Failure Mechanisms in Armor Composites With Ballistic Damage

Abstract: The overall objective is to develop a database of failure mechanisms and fracture properties in armor composites of interest to the Army. A building-block approach toward achieving this is suggested. The Phase I proposes investigating composites such as S2 glass/polyester and fiberglass/phenolic that has been subjected to ballistic damage. Phase I will choose three candidate composite systems for study, categorize required ballistic properties, and obtain panels for the test. The ballistic damage will be characterized using ultrasonic tests (through transmission and pulse-echo imaging). The panels will be ballistic tested as per MIL-STD-662. Fractures due to the ballistic damage will be characterized using scanning electron microscope (SEM) techniques. Correlations will be made between the fracture behavior, ballistic loads and material type. Phase II will propose expansion of the ballistic damage studies to include "real-world" variables including battlefield repair, fire and laser beam damage.

KARTA TECHNOLOGY, INC.
1892 GRANDSTAND
SAN ANTONIO, TX 78238
Phone: (512) 681-9102

Topic#: 92-133 ID#: 92MTL-183
Office: MTL
Contract #: DAAL01-93-C-4034
PI: Dr. Satish M. Nair

Title: A CAD-NDE Translator (CADNET) for the Ultrasonic Inspection of Contoured Ceramic Gas Turbine Components

Abstract: The automated inspection of gas turbine components has proven to be difficult due to their complex geometry. While ultrasonics has demonstrated excellent capabilities in detecting and characterizing the erosion and corrosion on turbine components from the hot effluent gases, it's application details laborious alignment procedures for the ultrasonic transducer during inspection. The need for automated inspection systems has become more pressing with the proposed next-generation gas turbine where ceramic materials are being considered for their high temperature capability and reduced cooling requirements. Critical flaw sizes for ceramics are smaller than those for metals and the ceramics fail catastrophically due to their brittle nature. A novel method for conducting the automated ultrasonic inspection of ceramic turbine blades and other complex-geometry gas turbine components is proposed. The innovation of this method lies in the development of a software package, called the CAD-NDE Translator (CADNET), which generates motion control commands from the CAD drawings of a complex geometry

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part. The motion control commands are used to instruct an inspection robot to closely follow the contour of the part. In Phase I, we will develop this translator. In Phase II, we will integrate this translator into a high-frequency ultrasonic system and evaluate it by conducting the automated inspection of ceramic turbine blades.

KNOWLEDGE INDUSTRIES
125 CALIFORNIA AVENUE, SUITE 201
PALO ALTO, CA 94306
Phone: (415) 321-9521
Topic#: 92-022 ID#: 92AVS-139
Office: AVSCOM
Contract #: DAAJ02-93-C-0004
PI: John S. Breese
Title: Probabilistic Expert Systems for Gas Turbine Diagnostics
Abstract: Knowledge Industries (KI) will explore the technical feasibility of applying probabilistic expert systems to development of T800 gas turbine diagnostics. KI is a leading developer of probabilistic expert systems and has developed other gas turbine diagnostic systems. In this project, KI will develop a prototype probabilistic expert system for the T800, investigate use of thermodynamic modeling as a component of a diagnostic system, and develop a software architecture and development plan for fielding a Phase II developed expert system. The basis of a probabilistic expert system is a probabilistic model of the faults and observables for a given diagnostic problem. We will use probabilistic causal networks called belief networks to model the relationships among important variables for the T800 gas turbine. Belief networks are a flexible and maintainable methodology for construction of large diagnostic systems. KI has developed state-of-the-art software tools and techniques for constructing and evaluating belief networks and we will evaluate the feasibility of probabilistic modeling of the T800 by constructing a prototype belief network and expert system, including a thermodynamic analysis of the engine. A major component of the program will focus on development of a software development and delivery plan for shop-based, line-based, and on-board diagnostics.

KNOWLEDGE SCIENCES, INC.
510 HIGHLANDS OVERLOOK
ROSWELL, GA 30075
Phone: (404) 641-0988
Topic#: 92-022 ID#: 92AVS-136
Office: AVSCOM
Contract #: DAAJ02-93-C-0003
PI: Brian D. Leighty
Title: Expert Diagnostics for Gas Turbine Engines
Abstract: A modern gas turbine engine such as the T800-LHT-800, which is to be used in the Army's Light Helicopter Experimental (LHX) Helicopter (now referred to as the RAH-66 Comanche), is among the most complex mechanical systems in use today. The parameters involved in diagnosing a fault are numerous and often subtly interrelated. The objective of Phase I is to define a system architecture for a diagnostic expert system that will aid engine maintenance personnel in locating engine faults. Phase I activities define the architecture for such a diagnostic expert system and demonstrate its feasibility and adequacy using a computer based simulation. A complete set of hardware and software components will be defined for subsequent detailed design and construction in Phase II. An approach using a diagnostic knowledge base consisting of both experiential knowledge (symptom-fault relationships) and functional engine knowledge (model based) will be investigated. The diagnostic reasoning process knowledge (meta-knowledge) will be defined that governs how the knowledge in the diagnostic knowledge base is to be used. The requirements for the inferencing mechanism used in processing all knowledge base data structures will be identified. Host computer component requirements will be identified including all system interface modules.

KTECH CORP.
901 PENNSYLVANIA AVE. NE
ALBUQUERQUE, AL 87110
Phone: (505) 268-3379
Topic#: 92-173 ID#: 92SDC-043
Office: SDC
Contract #: DASG60-93-C-0007
PI: Frank W. Davies
Title: EM Enhanced KE Projectile
Abstract: A feasibility study of an EM enhanced kinetic energy penetrator (EME penetrator) for ASAT application is proposed that negates the satellite's functional capabilities while minimizing space debris. The projectile is designed to penetrate the satellite and then generate a high amplitude EMP. Energizing the pulses after penetration minimizes the effectiveness of the satellite's EM shielding and closely couples the EMP signal to the targets electronic systems. This permits the modest electrical energies that can be stored in the projectile to be lethal. Since the Kill Mechanism is EM rather than KE debris production can be minimized. Confirmation that a satellite has been intercepted can be detected by monitoring. The study will determine the

feasibility of the concept, define the critical characteristics of each functional element, identify the risks associated with the development of the concept, and plan for the mitigation of those risks. Each of the critical technologies has been demonstrated. The challenge therefore is to synthesize a militarily useful system.

LEEP SYSTEMS, INC.
241 CRESCENT STREET
WALTHAM, MA 02154
Phone: (617) 647-1395
Topic#: 92-011 ID#: 92AVS-049
Office: AVSCOM
Contract #: NAS1-19484
PI: Eric Howlett
Title: A Head-Coupled Visual and Aural Sensor System for Teleoperated Rotorcraft Research Vehicle
Abstract: The objective of the Phase I program is a design of a stereoscopic and binaural telepresence system for remote piloting of the FFRRV helicopter. The system must afford the pilot on the ground a sense of "presence" in the cockpit - both visually and aurally - complete enough to permit aggressive and precise maneuvers. LEEP Systems will design a system based on its present technology, having a very wide angle of view for fast and accurate orientation in space as well as high resolution inserts for sharp views of distant features of the terrain. By this means the benefits of high resolution and wide angle can be simultaneously realized by just doubling the video bandwidth and of the electronic hardware, whereas without the inserts, getting vision substantially better than legal blindness requires unavailable components and a one hundred-fold increase in video bandwidth, which is not feasible. Along with AACOM Data Links, major consultants for telemetry equipment, LEEP brings to this task a unique breadth of experience and depth of skill, which is quite adequate to the task, as demonstrated repeatedly by innovations and by directly related products brought successfully to market. The anticipated work load will be readily accommodated.

M-DOT, INC.
3416 SOUTH 48TH STREET, SUITE 2
PHOENIX, AZ 85040
Phone: (602) 921-4128
Topic#: 92-052 ID#: 92MIC-047
Office: MICOM
Contract #: DAAHO1-93-C-R096
PI: Bryan J. Seegers
Title: Design, Fabrication and Test of a Thrust Spoiler/Reverser System for a Low Cost, Expendable Turbojet
Abstract: M-Dot, Inc. ("M-DOT") proposes to design, fabricate and test a thrust reverser system for low cost expendable turbojet engines. The system will be designed for application on the Sunstrand TJ-90 engine and will be configured for application on a bifurcated exhaust duct. The system will consist of the following: 1. Custom fabricated bifurcated exhaust duct for the TJ-90 engine. 2. Two pivoting vectoring ducts. One located at each exist. 3. Linkage and actuator for positioning the vectoring ducts. The Phase I program would accomplish the following: 1. Design and construction of a heavy wall thrust reversing system for ground test. 2. Bench testing to verify functionality of system. 3. Engine testing to verify performance and durability. 4. Compilation of design and test data. 5. Design layout of a flight weight system.

M.L. ENERGIA, INC.
P.O. BOX 1468
PRINCETON, NJ 08542
Phone: (609) 799-7970
Topic#: 92-061 ID#: 92MIC-049
Office: MICOM
Contract #: DAAHO1-93-C-R114
PI: Dr. Moshe Lavid
Title: Fluctuating Flowfield Density Measurement Over Wide Mach Number Range
Abstract: The Army has identified a need for fluctuating flowfield density measurements over a wide range of velocities. We propose to employ a new non-intrusive optical diagnostic technique which is applicable over a Mach number range from subsonic to hypersonic. The method is based on spectially filtered rotational Raman scattering and uses a newly developed ultraviolet solid state laser system, in conjunction with an atomic mercury vapor filter at 254.7 nm. The filter is used to block elastic and Rayleigh scattering, and transmit rotational Raman scattering. The use of an ultraviolet laser, and atomic vapor filter (as opposed to conventional spectrometer), results in significantly greater sensitivity than that of traditional vibrational Raman scattering. Modeling calculations indicate a potential density accuracy of +/- 1% at mean densities as low as 0.002 amagat. In this effort we propose a detailed study, including laboratory proof-of-concept measurements. An isotopically pure Hg vapor filter will be constructed, and its absorption characteristics determined. The study will employ a new, state-of-the-art, injection-seeded, frequency tripled, pulsed titanium-sapphire laser system. Extension to flow velocity and temperature measurement will also be explored.

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MACAULAY-BROWN, INC.
3915 GERMANY LANE
DAYTON, OH 45431
Phone: (513) 426-3421
Topic#: 93-008 ID#: 93EW-001
Office: CECOM
Contract #: DAAB07-93-C-U258
PI: Dr. Ernest E. Wisniewski
Title: Cooperative Infrared Jamming Techniques
Abstract: US Army Countermeasures (CMs) equipment developers have the responsibility to develop the capability to protect US Army aircraft against older, current and future threats. Under their direction new infrared (IR) jammers and decoys are being developed. Some of these new jammer CMs are designated to have a directional capability and are called directional infrared countermeasures (DIRCMs). Some of these DIRCM systems are planned to operate in a coordinated manner with IR decoy deployment. Previous studies and some field measurements have shown that cooperative use of IR decoys and jammers can enhance or if used improperly reduce overall IRCM effectiveness. This effort proposes developing a capability for quantifying, evaluating and optimizing the effectiveness of cooperative IR countermeasures and tactics. It will apply this capability to investigate using non-coherent DIRCM jammers in a cooperative way with fielded or near term developmental decoys to provide improvement in IRCM effectiveness over current equipment and tactics. Phase I addresses data gathering, definition and development of the structure for a database tool to help facilitate technique development and investigations and recommendations for a methodology to quantify, evaluate and optimize cooperative IRCM jamming-decoy dispense techniques.

MAINSTREAM ENGINEERING CORP.
PINES INDUSTRIAL CENTER, 200 YELLOW PLACE
ROCKLEDGE, FL 32955
Phone: (407) 631-3550
Topic#: 92-074 ID#: 92NAT-129
Office: NATICK
Contract #: DAAK60-93-C-0017
PI: R.P. Scaringe
Title: Demonstration of the Use of Hydrogen Fuel for Food Service
Abstract: Mainstream has a long and successful history of developing useful, easy-to-use hardware for heat and cooling applications [3-37]. This Phase I effort will investigate and demonstrate the use of hydrogen-powered food service system. Phase I will systematically investigate and define the best approach to integrate hydrogen fuel into food service operations. Included will be a study to determine optimum storage, transmission, and utilization methods. Based on the results of this study a conceptual model of a complete hydrogen-powered food service facility will be developed to demonstrate benefits and characterize the salient technical features (weight, cube, fuel usage and storage capacity, output). Phase I will also investigate the basic operating conditions required by the Army and design and demonstrate a working proof-of-principal prototype (to allow Army engineers to completely evaluate the concept's feasibility). Phase II will result in a development of fieldable-hardware for demonstration and evaluation in the field.

MAK TECHNOLOGIES, INC.
380 GREEN STREET
CAMBRIDGE, MA 02139
Phone: (617) 876-8085
Topic#: 92-098 ID#: 92STR-016
Office: STRICOM
Contract #: M67004-93-C-0039
PI: John Morrison
Title: Distributed Interactive Virtual Reality to Support Weapons Systems Concept Evaluations
Abstract: Evaluation of hypothetical weapons systems is costly in a BDS environment for two reasons. First, construction and modification of man-machine interfaces is costly and time-consuming. Secondly, construction and modification of network interfaces is costly and time-consuming, and often entails changes to older, pre-existing BDS software. MaK proposes to develop a Distributed Virtual Reality: an innovative, two-pronged approach to applying Virtual Reality to hypothetical weapons system concept evaluations. First, VR man-machine interface (MMI) technology will be evaluated for application to reconfigurable man-machine interfaces. Second, dynamic adaptive VR network protocols will be designed for application to reconfigurable inter-simulator interfaces. Based on extensive SIMNET simulator-construction experience and on-going research, MaK proposes trade studies to determine the suitability of current and planned VR MMI offerings for simulator MMIs. based on extensive experience with SIMNET network protocols, and on prior experience designing DIS protocol extensions, MaK will design dynamic, adaptive VR extensions to DIS 1.0 for inter-simulator interfaces.

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MANAGEMENT RESEARCH INSTITUTE
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BETHESDA, MD 20817
Phone: (703) 993-1344

Topic#: 92-154 ID#: 92ARI-011
Office: ARI
Contract #: MDA903-93-C-0081
PI: Michael D. Mumford, Ph.D.

Title: Cognitive and Metacognitive Skill Development: Alternative Measures for Predicting Leadership Potential

Abstract: Leaders must be able to solve the kind of complex, ambiguous problems that arise in organizational settings. Prior research on the determinants of leader performance indicates that metacognitive skills, such as problem construction and integration, have a marked impact on people's ability to solve complex, ambiguous problems. In the effort proposed herein, the literature on cognitive processes and cognitive development in adulthood will be used to construct a model describing how metacognitive skills influence (1) the development of viable knowledge structures and (2) effective processing of knowledge in problem solving. This model will then be used to identify potential measures of each of these metacognitive skills, and automated measures of certain crucial skills will be developed. The reliability and validity of these measures will then be established in a pilot study. Additionally, this model will be used to identify interventions that might accelerate skills development. A set of self-paced, computer-interactive training programs will then be constructed, and their influence on effective application of metacognitive skills in problem solving will be assessed. The validation evidence provided by these studies should provide the infrastructure for future efforts intended to enhance leaders' problem solving skills.

MATERIALS & ELECTROCHEMICAL RESEARCH
7960 S. KOLB RD
TUCSON, AZ 85706
Phone: (602) 574-1980

Topic#: 92-102 ID#: 92ARO-039
Office: ARO
Contract #: DAAH04-93-C-0004
PI: Dr. R.O. Loutfy

Title: Novel Materials for Hydrogen Supplies and Storage for Fuel Cells

Abstract: A novel and newly discovered C60 carbon material was found to exhibit unique electrochemical and physical properties. C60 and catalyzed C60 electrodes for hydrogen storage and supplies will be fabricated by vapor deposition and dry pressing. These electrodes will be fully characterized as hydrogen electrodes in C60Hx-air fuel cells. The nature of the electrochemical hydrogenation and dehydrogenation of C60 as a function of environmental conditions will be established. A fuel cell will also be characterized including its self-discharge, charge and discharge characteristics and efficiency to establish the viability of HTIS system as a low cost, light weight, high power density secondary battery for producing power on the battlefield.

MATERIALS & ELECTROCHEMICAL RESEARCH
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Topic#: 92-131 ID#: 92MTL-164
Office: MTL
Contract #: DAAL01-93-C-4017
PI: Dr. S. Guha

Title: Low Cost Method for Synthesis of [100]-W Reinforced Heavy Alloys for Kinetic Energy Penetrators

Abstract: Single crystals of tungsten (W) with [100] orientation have been demonstrated to exhibit ballistically equivalent performance to depleted uranium (DU) projectiles. Single crystals of W are unfortunately brittle. Also, the state-of-the-art crystal growing techniques limits the diameter of such crystals to less than 10mm. Hence, it is proposed to fabricate tungsten heavy alloy (WHA) projectiles consisting of [100] oriented whiskers/fibers held in a Ni-Fe type matrix. This proposal will address the problems of growing [100] W whiskers/fibers in a heavy alloy matrix. The whiskers/fibers will be grown by the proven VLS process in which MER has considerable expertise (prior experience in growth of SiC and TiB2 whiskers) using a [100] W single crystal substrate, a mixture of WCl6 and H2 as the reactant gases and a Ni-based catalyst (Ni-Fe, Ni-Co, Ni-Cu). The whiskers/fibers will be harvested, cold-pressed and infiltrated in-situ by the catalyst (by varying temperature and atmosphere to promote wetting). This will demonstrate processing that can produce projectiles (> 10mm in diameter) for ballistic evaluation. A test scale WHA composite synthesized through the above process will be delivered to the program technical monitor.

MATERIALS MODIFICATION, INC.
2929-P1 ESKRIDGE CENTER
FAIRFAX, VA 22031
Phone: (703) 560-1371

Topic#: 92-137 ID#: 92MTL-215
Office: MTL
Contract #: DAAL01-92-C-4038
PI: Dr. T. S. Sudarshan

Title: Synthesis of Nanocrystalline Tungsten Powder
Abstract: Kinetic energy projectiles and shaped charge liners as well as explosively formed projectile warheads would be more effective if tungsten having significant room temperature ductility were available. Nano-sized particles are known to provide these levels of desired ductility. In this Phase I effort, we propose three different approaches to producing tungsten nano-particles. Each technology is unique and nano-particles will be produced under optimum processing conditions. In Phase II we will concentrate on one of the three approaches, optimize the processing parameters so that mechanical properties evaluation and fabrication of a penetrator shape will be feasible.

MAYFLOWER COMMUNICATIONS CO., INC.
80 MAIN STREET
READING, MA 01867
Phone: (617) 942-2666
Topic#: 92-175 ID#: 92SDC-072
Office: SDC
Contract #: DASG60-93-C-0011
PI: Dr. Jorge I. Galdos
Title: Improved Real-time Ionospheric Compensation for Kwajalein Missile Range (KMR) Radars
Abstract: ALTAIR range correction when dual-frequency tracking is unavailable, and ALTAIR elevation corrections with or without dual-frequency tracking depend critically on the accurate characterization of the ionosphere along the ray paths to the trajectory of the traced object. The techniques currently implemented at ALTAIR and other KWR radars do not reflect the advances in ionospheric modeling and sensor technology that have become available during the last ten years. This proposal formulates an innovative advanced development program to upgrade these techniques and maximize radar tracking accuracy. The proposed work will analyze the capabilities of the most advanced low-latitude ionospheric model —SLIM, FAIM, ICED, and PRISM -- for use in ALTAIR range and elevation corrections. Because significant spatial and temporal fluctuations of the ionosphere cannot be predicted by any model, a concept is developed to update the ionospheric model in real-time using a sensor integration approach which uses the capabilities made available by the Global Positioning Systems (GPS).

MERIX CORP.
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NEEDHAM HEIGHTS, MA 02194
Phone: (617) 455-8877
Topic#: 92-073 ID#: 92NAT-124
Office: NATICK
Contract #: DAAK60-93-C-0027
PI: Dr. Thomas W. Mix
Title: Improved Pressurized Fabric Arches
Abstract: Pressure stabilized arches, consisting of curved fabric tubes with closed ends and a valve for inflation and air retention, show promise as lightweight, quickly-erectable support structures for Army tents. Various methods for producing the pressurized air beams have been explored. The current method of arch fabrication is to cut patterns from flat fabric, and sew or cement seams to form the curved tube and end closure, with air-retention provided by a separate internal bladder or a coating. This method is labor intensive, and the resulting seams provide a large number of potential initiation sites for tube failure. The Army is currently pursuing both 3-D weaving and braiding approaches for producing the curved arches; however, these techniques are still in the developmental stages. Merix proposes to develop an automated method to inexpensively form the arches directly from non-woven fabric, with no seams. The Merix process should be less expensive that 3-D weaving and braiding, and should eliminate the possibility for defects in the 3-D weaving and braiding processes to degrade the arch support capabilities of the structure.

MICHAEL & ASSOC., INC.
246 WOODLAND DRIVE
STATE COLLEGE, PA 16803
Phone: (814) 234-7042
Topic#: 93-027 ID#: 93HEL-040
Office: HEL
Contract #: DAAA15-93-C-0051
PI: Kevin L. Michael, Ph.D.
Title: Development of a Digital Auditory/Speech Processor
Abstract: The objectives of Phase I of this project are as follows: 1) to develop the digital signal processing algorithms necessary to improve the intelligibility of speech degraded by noise, 2) to develop the software that will implement these algorithms, and 3) to evaluate the effectiveness of the speech enhancement software on one human subject in different laboratory noise environments using a Motorola 56001-based workstation. The algorithms developed in this research effort will be based on the critical band model of the human ear. The critical band model has been the basis of research efforts in the past concerning noise-induced hearing loss, presbycusis, and speech recognition. Little effort, however, has been made to use critical band

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theory in the field of speech enhancement. The effectiveness of the speech enhancement system developed in this effort will be judged both objectively and subjectively. A battery of speech recognition tests will be employed in several noise environments under several signal-to-noise ratios. Subjective quality assessments from the listeners will also be obtained. Although the emphasis of this research will be on speech enhancement, the algorithms developed will be applicable to any known or predictable target signal.

MICRO COMPOSITE MATERIALS CORP.
4608-D INDUSTRY LANE
DURHAM, NC 27713
Phone: (919) 361-3535

Topic#: 92-012 ID#: 92AVS-062
Office: AVSCOM
Contract #: DAAJ02-93-C-0015
PI: Dr. Steve R. Wright

Title: Novel Inlet Protection System for Auxiliary Power Units Using Boundary-Layer Momentum Transfer Technology

Abstract: Ingested particulates, especially sand, severely degrade performance and increase wear in small gas turbine engines used in helicopter auxiliary and secondary power units. Existing Inlet Particle Separator (IPS) systems based on Bortex tube designs have two major limitations: their efficiency decreases with the size of particulate matter, and they are difficult and expensive to retrofit in existing APU/SPUs. The objectives of this project are to develop and assess a novel IPS system based on a boundary-layer momentum transfer concept that will greatly improve the efficiency of particle removal while operating within the performance and spatial parameters of existing APU/SPUs. Prior research has shown this technique to be very efficient at removing particulates from unconstrained gaseous streams. The thrust of Phase I research is to use computer simulation modelling to analyze the trade-offs between particle removal efficiency, pressure loss, airflow, size and weight of an IPS that can be adapted to existing APU/SPUs. The resulting criteria will be used to evaluate production/retrofit costs and to create a preliminary IPS design emphasizing the highest efficiency for the lowest cost and size. Subsequent development, fabrication and testing of a prototype in phase II will confirm the efficiency and airworthiness of the novel IPS.

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TULLAHOMA, TN 37388
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Topic#: 93-005 ID#: 93VPD-001
Office: AVSCOM
Contract #: NAS3-27020
PI: Thomas R. Tyler, Jr.

Title: Low Cost Turbo Machinery Models for Aerodynamic Testing

Abstract: The use of rapid prototyping (RP) techniques, such as stereolithography, is proposed for the low-cost, rapid-turnaround manufacture of ready-to-test turbomachinery test hardware. The authors of this proposal were responsible for two recent test rig programs in which stereolithography was used. In one program a turbine rig model to test CFD design methodology for the Space Transportation Main Engine (STME) turbopumps, stereolithography rotating models of actual hardware were produced to test different inlets under low-speed conditions. This helped to identify design improvements but could not be used to greatly impact on the actual cost of generating testworthy hardware. In the second, a turbopump rig program for deep space mission rockets (AETB), pump impeller models were manufactured for visualization of designs and generation of tooling. The purpose of this proposal is to explore and improve the state of the art of the materials and manufacturing methods to reduce the time and cost of designing and fabricating highly instrumented turbomachinery test rigs. The Phase I effort will be directed at the choice of materials and improved manufacturing techniques. Phase II effort will be to fabricate a suitable, workable, test model making optimum use of these new materials.

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Topic#: 92-113 ID#: 92ETD-004
Office: ETDL
Contract #: DAAL01-93-C-3306
PI: Cesar E. Alvarez, Jr.

Title: Enhanced Architecture for Direct Digital Synthesizer (DDS) Designs

Abstract: The proposed research is in the area of new architectures for a Direct Digital Synthesizer (DDS). Current DDS architectures employ a phase accumulator, incremented each sample clock by a phase increment word. By controlling this word the rate (frequency) at which the accumulator overflows is controlled. The result is a stable programmable frequency source. The accumulator phase information is applied to a ROM in order to convert the phase information into a digitized order to convert the phase information into a digitized sine waveform. The digitized wave is applied to a D/A converter and a low pass

filter to generate the final waveform. Due to finite word lengths and the physical limitations of the architecture, phase and amplitude noise spurs are introduced during this process. Increasing the word lengths can reduce the noise spurs by about 6db per bit. What is proposed is two innovations that could reduce the noise spurs by more than 6db per bit and thereby enhance the spectral purity of the generated waveform. To accomplish this the research proposes the use of: 1) New number systems with certainly more desirable properties. 2) Approximation theory involving reduced computed computations.

MILLITECH CORP.
P.O. BOX 109, SOUTH DEERFIELD RESEARCH PARK
SOUTH DEERFIELD, MA 01373
Phone: (413) 665-8551
Topic#: 92-056 ID#: 92MIC-033
Office: MICOM
Contract #: DAAHO1-93-C-R152
PI: Ellen L. Moore
Title: Millimeter Wave Spatial Power Combining Techniques
Abstract: Many millimeter wave radar and communications applications require total RF output power of 30W or more. Since one solid state three-terminal amplifier can deliver less than a watt at these frequencies, the outputs of several devices must be combined to achieve the power levels desired. Conventional power combining circuits become expensive and inefficient for large numbers of devices. However, spatial power combining via quasi-optical techniques improves efficiency by replacing much of the transmission line with lenses and feeds, thus allowing arrays with many amplifiers to give a net power increase. Our study will include practical tradeoffs of a quasi-optical power combiner having an output power goal of 10-100W in the millimeter wave range. The study will include improved lenses, feeds and planar media giving optimum efficiency, size, weight, thermal performance, impedance matching and manufacturability. Phase I will comprise a goal definition and block diagram followed by a study of tradeoffs in packing density, area, volume, antennas and amplifier transmission media. The prototype we design in Phase I will be built in Phase II. These devices can be commercialized in automobile collision avoidance radars and all weather landing systems, already under development at Millitech.

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Office: CECOM
Contract #: DAAB10-93-C-0019
PI: Maria King
Title: A Secure Shell Toolkit for Unix Based Intelligence and Electronic Warfare (IEW) Applications
Abstract: This research proposes the development of a toolkit that provides security functionality required by IEW applications targeted for Unix platforms in order to meet DIA accreditation criteria for System High mode. Many versions of Unix are available and only a few are considered to be secure thus requiring security functionality to be implemented in the IEW application. The idea of the toolkit is to move the required security functionality out of the application and the operating system, regardless of the targeted version of Unix. A well-defined and controlled interface to the toolkit will be implemented using object-oriented techniques. Interaction with the toolkit is restricted to this interface. The toolkit interface and behavior will always remain the same, only its internals may change in order to port the toolkit to another platform. The advantage of this object-oriented approach is that it forces the application to access the toolkit through a well-defined, controlled interface, thus isolating the application from the Unix operating system.

MISSION RESEARCH CORP.
735 STATE STREET, P.O. DRAWER 719
SANTA BARBARA, CA 93102
Phone: (714) 754-1300
Topic#: 92-071 ID#: 92NAT-117
Office: NATICK
Contract #: DAAK60-93-C-0024
PI: Mr. Robert Eisler
Title: Improved Individual Ballistic Protective Fibers/Material Systems for Body Armor
Abstract: The proposed effort incorporates an analytical approach to support development and optimization of an improved individual ballistic protective material system for body armor which incorporates poly vinyl alcohol (PVA) fibers. The approach relies on a hierarchy of analytical models describing the mechanical and ballistic performance of fibers, yarns, and fabrics. The models are then exercised to determine parametric sensitivities in terms of fiber, yarn, and fabric properties. Insights garnered from this activity are then used to guide subsequent PVA fiber development. The five tasks proposed include: (1) Analytical Model Development; (2) Parameter Studies; (3) Experimental determination of fiber and yarn deformation modes; (4) Development of a Phase II Plan; and, (5) Preparation of deliverables. The analytical model development is also divided into

four subtasks which describe: (a) Fiber mechanical properties in the longitudinal and lateral direction; (b) Multitow mechanical properties; (c) Favorable yarn geometries; and, (d) Deformation and failure modes of the fiber, yarn, and fabric.

MOSET CORP.
2507 RIVENDELL
LAKE FOREST, CA 92630
Phone: (714) 768-8549

Topic#: 92-043 ID#: 92NV-031
Office: CECOM
Contract #: DAAB07-93-C-U007
PI: Ken R. Zanio

Title: Infrared (IR) Materials Growth and Detector Processing Technology for Monolithic Dual-Band Detectors

Abstract: The overall objective of this effort is to provide monolithic activity on GaAs/Si substrates for dual-band (3-5 and 8-12 micron) focal plane arrays (FPAs). More specifically to: 1) Determine the most promising GaAs/Si monolithic dual-band approach, 2) Identify Si readout (R/O) circuits, 3) Plan critical material and detector experiments, 4) Provide a monolithic dual-band FPA process, and 5) Layout FPAs and test circuits for 4" Si wafers. This effort will be based upon the authors' earlier work which replaced In bonds in hybrid FPAs by conformal thin films that interconnect HgCdTe detectors to R/Os in the same Si wafer. The proposed effort will extend this single-band monolithic technology to dual-band FPAs. The effort will determine the best dual-band unit cell in either a tandem or adjacent configuration using HgCdTe for the MWIR and either HgCdTe or AlGaAs quantum wells for the LWIR. R/O design will share charge between the unit cell capacitors and columns to increase signal-to-noise but yet maintain a small cell. The effort will plan experiments for processing the R/Os and detectors and for growing and fabricating detectors on GaAs/Si. The effort will deliver a dual-band process and a layout for 4" Si wafers that will include test structures and a 8 x 8 and another larger dual-band FPA.

MSNW, INC.
P. O. BOX 865
SAN MARCOS, CA 92079
Phone: (619) 489-9471

Topic#: 92-135 ID#: 92MTL-116
Office: MTL
Contract #: DAAL01-93-C-4020
PI: Dr. George H. Reynolds

Title: Continuous Titanium Carbide Monofilaments for Reinforcement of Titanium Metal Matrix Composites

Abstract: The Phase I research will produce and evaluate continuous TiC1-x monofilaments having improved thermochemical and thermomechanical compatibility in high Ti content (beta alloys, orthorhombics, and a-2 titanium aluminide) matrices. Continuous binary carbide monofilament compositions will be prepared by direct chemical vapor deposition onto small diameter resistance-heated core monofilaments or wires or, alternatively, by reactive conversion of small diameter Ti core wires. The product monofilaments will be characterized by optical and electron microscopy with x-ray analysis for microstructure and chemical uniformity and through room temperature mechanical property measurements. Specimen continuous monofilaments will be supplied to MTL for independent evaluation. Prototype composites will be prepared and the thermochemical stability of the binary composition monofilaments determined by microchemical analysis of near-interfacial composition profiles. The project will be performed with the assistance of Pratt & Whitney Aircraft-Florida, who will prepare the prototype composites for joint evaluation.

MSP CORP.
1313 FIFTH STREET SE, SUITE 206
MINNEAPOLIS, MN 55414
Phone: (612) 379-3963

Topic#: 92-048 ID#: 92CRD-015
Office: CRDEC
Contract #: DAAA15-93-C-0013
PI: David Thimsen

Title: Lightweight TOF Mass Spectrometer with Atmospheric Pressure Inlet

Abstract: The objective of the proposed work is to design a lightweight mass spectrometer system based on a time of flight mass spectrometer with atmospheric pressure ion source. It is expected that this device will be able to measure ppb concentrations of atomic species in the 50-300 charge-to-atomic mass ratio range. Supporting electronics will be engineered from experience on constructing electronics packages for rocket launching into the upper atmosphere of Earth and Mars. The supporting vacuum system will be engineered as part of the entire package. Design limitations for the package are a maximum weight of 20lb, maximum power consumption of 250 wt.

NAMBETECH, INC.
RT. 1, BOX 204H
SANTA FE, NM 87501
Phone: (505) 455-7620
Topic#: 92-025 ID#: 92BRD-035
Office: BRDEC
Contract #: DAAK70-93-C-0038
PI: Dr. Daniel C. Barnes
Title: Portable, Lightweight Neutron Source for Mine Detection
Abstract: It is proposed to develop a portable, lightweight neutron source for detection and location of mines via nuclear activation of the high-explosive material (HE). It is further proposed to develop the technical base required to plan a demonstration of neutron activation of HE base mine detection in a field environment. The latter task requires a study of neutron transport from the source, through the intervening soil, and the interaction of the resulting neutron spectrum with a HE target surrounded by the remaining components of a mine. In addition, a combined boom-mounted source/detector package will be conceptually designed.

NOISE REMOVAL SYSTEMS
DR. TOM HARLEY, ROUTE 2 BOX 635
OXFORD, MS 38655
Phone: (601) 234-5359
Topic#: 92-160 ID#: 92MED-080
Office: MEDICAL
Contract #: DAMD17-93-C-3088
PI: Dr. Tom Harley
Title: An Active Noise Control Stethoscope
Abstract: The objective of the proposed work is to develop an electronic stethoscope that enables emergency medical personnel to check vital signs in the presence of high background noise levels. Often physicians in military vehicles and other noisy environments are unable to auscultate. The relevant stethoscope audio signal becomes unintelligible when masked by prohibitively loud noises. The proposed electronic stethoscope will allow physicians to clearly hear sounds used to monitor the lung, heart, and blood pressure of patients. The design of the electronic stethoscope incorporates active noise control and adaptive digital signal processing technology. A functional breadboard prototype has already been developed for removing cyclical or repetitive noise. During Phase I of the project, the software used by the controller will be combined with previously developed algorithms for canceling (non-erodic) noise. A detailed cost analysis of the targeted commercial project will be made. Several specific noisy environments of interest will be simulated in the laboratory. Demonstrations of the active noise control breadboard prototype will be given to stethoscope manufacturing companies in an effort to obtain a contingency commitment for follow-on support and licensing at the completion of Phase II.

NOVA MANAGEMENT, INC.
1029 LOCHNESS COURT
SUNNYVALE, CA 94087
Phone: (408) 373-1056
Topic#: 92-087 ID#: 92TAC-114
Office: TACOM
Contract #: DAAE07-93-C-R026
PI: John E. Tope
Title: Electronic Map Display and Route Planner
Abstract: Manual planning with paper maps will be even more difficult and time consuming if combat vehicle crew sizes are reduced. Robotic combat vehicle systems require electronic map display and route planning as an essential element of these systems. This project will develop an electronic map display and route planner (EMDRP). This project is the first phase of a development program that will end with an electronic circuit board module that will perform the electronic map display and route planner functions. The module hardware and software will be compatible with the Standard Army Vetronics Architecture. The project will: 1. Review research and formulate plans and software for EMDRP; 2. Evaluate potential of flat panel display technology; 3. Define an EMDRP concept; 4. Validate software algorithms to support the system; and 5. Provide a final report. In performing this project NOVA Management, Inc. will draw upon the experience of its subcontractor FMC Corporation Corporate Technology Center in route planning technology. Specific emphasis will be placed on the FMC High Speed Path Optimization Co-Processor (HSPOP) based on advanced dynamic programming techniques in an ASIC form that does the route selection functions.

NOVA MANAGEMENT, INC.
1029 LOCHNESS COURT
SUNNYVALE, CA 94087
Phone: (408) 373-1056
Topic#: 92-089 ID#: 92TAC-141
Office: TACOM
Contract #: DAAE07-93-C-R030
PI: John E. Tope

Title: Embedded Training for Integrated Two-man Crew Station
Abstract: The Integrated Two-man Crew Station (ITCS) will be used with the Vetronics Crew Display Demonstrator (VCDD) in experiments to define the optimum crew size and crew station configuration for vehicles of the future. These laboratory facilities will be integrated with items from the Standard Army Vetronics Architecture (SAVA) program. This project will define and demonstrate an embedded training system that will permit combat vehicle crew persons to train in their simulated vehicle crew station. The embedded training system will be integrated into hardware and software of VCDD, ITCS and SAVA modules. The project will: 1. Define requirements for ETITCS software based upon prior research with specific emphasis on the M2/M3 type infantry fighting vehicle; 2. Design and develop specific training and special hardware or software items for use with the VCDD and ITCS systems; 3. Conduct a demonstration using the ETITCS software on a VCDD crew station in the Vetronics Laboratory; and 4. Provide a final report and Phase II Plan. In performing this project NOVA Management, Inc. will draw upon the experience of its subcontractor FMC Corporation Corporate Technology Center in training system development.

OCA APPLIED OPTICS
7421 ORANGEWOOD AVENUE
GARDEN GROVE, CA 92641
Phone: (714) 895-1667
Topic#: 92-060 ID#: 92MIC-084
Office: MICOM
Contract #: DAAHO1-93-C-R139
PI: Fred Hesse
Title: Day/Night Low Light Level TV Sensor
Abstract: As a Phase I effort, OCA proposes to develop a design for a day/night low light level TV camera system. This is a system composed of a lens assembly with variable iris, a Gen III (dual microchannel plate) image intensifier with variable gain and a gated photo-cathode, a CCD camera with automatic gain control, auto level control and noise reduction filter that performs under illumination levels between 10 E-4 to 10 E 4 foot candles. OCA will adapt a major part of its present Brilliant Pebbles intensive CCD camera design to meet these requirements. OCA will evaluate a number of recent technical advancements with the goal of incorporating these into a new and improved design. These innovations include utilization of new application specific analog integrated circuits for CCD signal processing; miniaturization through the use of multi-chip-modules for electronic packaging; use of 5 to 8 micron diameter microchannel plates; an intensifier power supply with auto brightness control, variable gain, bright source protection, that operates at 800 KHz; tapered fractal fiberoptics; variable edge control for intensifier gating, vapor deposited Paralene insulation in place of solid potting for high voltage. OCA will apply a systems approach to the design in order to prepare a System Requirements Specification, perform an end to end photometry analysis, and develop the subsystem design.

ONTAR CORP.
129 UNIVERSITY ROAD
BROOKLINE, MA 02146
Phone: (617) 739-6607
Topic#: 92-092 ID#: 92TEC-043
Office: TECOM
Contract #: DAAD09-93-C-0019
PI: Dr. John Schroeder
Title: Automatic Smoke and Obscurant Cloud PR from Visible and Thermal Imagery
Abstract: The US Army has a requirement to develop and deploy systems to automatically detect smoke and obscurant clouds using visible and infrared imagery. The proposed program will implement a method to determine the spatial extent of clouds using a combination of techniques such as advanced image processing, pattern recognition, knowledge based procedures (KBP), and neural networks (NN). The complexity of detection systems requires highly sophisticated algorithms for operations such as classification, recognition identification and characterization. The capabilities of systems to perform on-board, real-time processing has increased enormously over the past several years. The objectives of this work are to perform the research and implement the software to develop a system for the development and evaluation of algorithms for cloud detection and classification. Phase I will encompass the implementation of a simple system for algorithm evaluation, and make recommendations for a hardware platform and software development. Extensive development and validation will be completed in Phase II.

OPERATIONAL TECHNOLOGIES CORP.
4100 N.W. LOOP 410, SUITE 230
SAN ANTONIO, TX 78229
Phone: (512) 731-0000
Topic#: 92-153 ID#: 92ARI-010
Office: ARI
Contract #: MDA903-93-C-0111
PI: Benjamin A. Fairbank, Ph.

Title: A Propensity Score Model of Costs and Benefits Related to Army Service
Abstract: A major obstacle to the establishment and measurement of valid cause and effect relationships between Army service and the costs and benefits of such service is the impossibility of performing experiments with random assignment of individuals to service and non-service groups. A recent innovation in statistical theory, propensity score methodology, allows one to draw from an observational (or retrospective) study virtually the same kind of causal inferences that previously have been possible only with experimental studies. Propensity score methodology has been successfully used in medical, social science, and educational contexts. Phase I will develop a specimen propensity score model of costs and benefits of Army service, will identify and specify the data sources necessary to implement and test the model, and will determine the procedures and scope of the effort needed to test the model. Phase I will include a preliminary specification of the variables appropriate for use in the final model. Attention will be given to the question of oversampling women and minorities so that separate models may be developed for them. Not only are such separate models desirable heuristically, they are also particularly appropriate when using propensity scores. Phase II will be devoted to the elaboration, detailed specification, testing, and evaluation of the model.

OPTOELECTRONIC DATA SYSTEMS
310 SOUTH 42ND STREET
BOULDER, CO 80303
Phone: (303) 541-9220
Topic#: 92-063 ID#: 92MIC-080
Office: MICOM
Contract #: DAAHO1-93-C-R147
PI: David Jared
Title: Convolving Optically Addressed VLSI Liquid Crystal Spatial Light Modulator
Abstract: The principle objective of the proposed research program is the development of a novel spatial light modulator that calculates a 3 x 3 kernel convolution on an input image. The spatial light modulator consists of a ferroelectric liquid crystal modulator on top of a CMOS VLSI chip. During Phase I, a comprehensive study of several convolving SLM designs will be performed. The study will examine circuit level details and system level details. A test chip containing sub-circuits of several SLM designs will be designed, fabricated and tested.

ORBITAL RESEARCH, INC.
SUITE 461, 11000 CEDAR AVENUE
CLEVELAND, OH 44106
Phone: (216) 791-6720
Topic#: 93-029 ID#: 93CER-010
Office: CERL
Contract #: DACA88-93-C-0014
PI: Robert N. Schmidt
Title: Fiber Reinforced Rebar from Recycled Plastic
Abstract: Recycling of plastic containers has been retarded by the lack of demand for plastic scrap. This is due to the dearth of products manufactured from recycled plastics. One of the reasons for this is the poor quality surface finish which is obtainable from recycled plastics such as high density polyethylene (HDPE) used in milk and liquid detergent bottles. Another problem facing our country is the decaying infrastructure. Road salt causes concrete reinforcing rods to rust, which causes concrete to spall, thus deteriorating bridges, airfields, and parking garages. Similarly, reinforced concrete in wharves, locks, and other marine facilities are degraded by the same mechanism. An economical solution to both of these problems can be achieved by recycling plastic resins into glass fiber reinforced composites to manufacture a non-rusting reinforcing bar for concrete structures. This can be achieved economically with existing technology. Orbital Research has already manufactured compression molded glass fiber reinforced HDPE composites made from recycled plastic. This SBIR will develop an extruded/pultruded glass reinforced rebar. In Phase I, extruded/pultruded rebar will be fabricated in small quantities and tested in a laboratory. Phase II will fabricate large quantities of different sizes of rebars and test them in various types of concrete applications.

ORINCON CORP.
9363 TOWNE CENTRE DRIVE
SAN DIEGO, CA 92121
Phone: (619) 455-5530
Topic#: 92-026 ID#: 92BRD-072
Office: BRDEC
Contract #: DAAK70-93-C-0029
PI: Mr. Donald K. Owen
Title: Intrusion Detection from a Moving Platform
Abstract: Intruder detection using a mobile platform with multiple sensor suites is difficult because of the ever-changing warehouse environments in which the robots operate. Doppler shifts caused by platform motion or intruder motion also add to the problem. ORINCON proposes a novel approach to intruder detection that uses a statistical differencing technique on

multiple-sensor-suite digitized snapshots at preprogrammed locations in the environment. Image differencing of digitized video camera frames has been used successfully in industry to detect intruders by detecting changes in the background from frame to frame. ORINCON takes this notion a step further. First, during initialization, a robot takes several digitized sensor snapshot measurements along a preprogrammed path and stores the data and the measurement locations. On subsequent path passes, the snapshot measurements-taken at the same locations-are compared to the initialization measurements by differencing. If "significant" discrepancies exist, then an intruder detection is determined to have occurred. If not, then the most recent snapshot is stored for the next pass. The main thrust of the proposed work will be to determine what "significant" discrepancies are and how they are related to probability of detection and probability of false alarm.

ORINCON CORP.
9363 TOWNE CENTRE DRIVE
SAN DIEGO, CA 92121
Phone: (619) 455-5530
Topic#: 92-121 ID#: 92HDL-031
Office: HDL
Contract #: DAAL02-93-C-0017
PI: Dr Thomas W. Brotherton
Title: Knowledge-based Target Classification Using Baseband Doppler Audio Frequency
Abstract: In analysis of basebanded Doppler radar signals, it has been noted that trained operators can classify target types by aural analysis of the baseband signals. This implies that there is sufficient structure in the signal so that automated analysis using speech processing techniques can perform classification. Standard analysis techniques assume that the data is stationary and well modeled using Fourier transformations of the data. The resulting spectrum is used to determine signal components that are then used for classification. Unfortunately, the audio signals of interest are highly non-stationary and can even contain sequences of pulses. The standard Fourier spectral analysis techniques cannot determine the time-varying structure within the data and thus do not provide sufficient features for classification. It is this time-varying structure that gives the operator the clues he needs for classification. ORINCON proposes to develop and demonstrate an automated system that uses high-resolution time/frequency representations to characterize the data. The feature extractor is coupled with a neural network to solve the classification problems. Neural networks have been used extensively and successfully at ORINCON to solve detection/classification problems in underwater acoustics, as well as for fault detection/classification problems in rotating machinery. This technology is directly applicable to the classification problem for baseband Doppler radar return signals.

P C DYNAMICS
2906 FM 720 EAST
FRISCO, TX 75034
Phone: (214) 335-9841
Topic#: 92-124 ID#: 92HDL-059
Office: HDL
Contract #: DAAL02-93-C-0029
PI: Lawrence D. Harvey
Title: Solder Plating Process Control
Abstract: The objective of this proposal is to develop and implement a scientifically based solderability tester as a process control tool during the fabrication process for printed circuit boards. Using the sequential electrochemical reduction analysis (SERA) process as invented by Rockwell International, data will be gathered to correlate the coulomb density values determined by SERA to current, commercial solderability testing as described in IPC-5-804. Designed experimentation methods will be used to determine the key process characteristics that can be controlled as a result of the information available through the SERA test method. In addition, the SERA test equipment will be evaluated for its ability to withstand the normal production environment and possible design improvement recommendations will be made to enhance its ability to withstand the environment.

PACIFIC ADVANCED TECHNOLOGY
P.O. BOX 679, 1001 CROFT LANE
SOLVANG, CA 93464
Phone: (805) 688-2088
Topic#: 92-036 ID#: 92EW-007
Office: CECOM
Contract #: DAAB07-93-C-U259
PI: Michele Hinnrichs
Title: Continuous Wave (CW) Laser Detection Techniques
Abstract: Pacific Advanced Technology (PAT) is pleased to propose a new and creative solution to single aperture multi-spectral laser warning. Our proposed approach to laser warning can detect multiple laser spectral bands with a single aperture over a wide field of view and determine angle of arrival with in less than a degree. As an example of the multi-spectral nature of this approach, a laser in the midwave infrared as well as a longwave infrared can be detected with a single aperture, thus minimizing modifications to existing platforms and reduce sensor costs due to less components needed. This proposal approach to laser

warning uses speckle gram interferometry to perform optical signal processing for coherence detection, coupled with neural network signal processing for classification and direction of arrival. Using neural networks on the focal plane array to perform the post signal processing will enable real time detection, discrimination and warning in a light weight small package. This new technology allows the straight forward manufacture of a simple, compact optical system which will detect and warn against laser threats. During the phase I portion of this SBIR we will model the PAT proposed laser warning approach for the Army's CW threats using the PAT laser warning computer simulation model. We will also perform a first order design of the neural network signal processor that is an integral part of the PAT approach to a laser warning system. To our knowledge this approach to laser warning has not been discussed, offered or pursued elsewhere in the Department of Defense.

PAI CORP.
116 MILAN WAY
OAK RIDGE, TN 37830
Phone: (615) 483-0666
Topic#: 92-141 ID#: 92CER-021
Office: CERL
Contract #: DACA88-93-C-0003
PI: Herbert W. Hoffman, Ph.D.
Title: Lead Paint Removal by Confined Hydraulic Jet
Abstract: This project will devise and develop an efficient and cost-effective technique for removing lead-contaminated paint films from painted surfaces in Army buildings scheduled for demolition. High-pressure water jets confined within a shield (operating head) remove the paint from the surface. The operating head is sealed against the work surface by flexible flange. Small channels in the flange allow the air entering the operating head at high velocity. The air/water/paint film residue mixture is drawn out by an air compressor which discharged the moisture through a centrifugal separator and a filter into the atmosphere. The separated water and paint mixture passes to a series of tanks in which centrifugation, settling, and filtration processes remove the paint residue from the wash water. Recirculation of the cleaned wash water through a positive-displacement pump supplying the jets minimizes the volume of waste water requiring disposal. The film solids are collected and concentrated for disposal as hazardous waste. The process raises no institutional issues. Phase I will compare the proposed technique with existent processes, identify feasibility issues, prepare a verification test plan, perform necessary performance scoping tests, and gauge development success probability. Phase II will design, procure, and assemble a prototype device; carry out laboratory and field verification tests; and identify commercial/industrial participants.

PERIGEE WEST COMPANY
P.O. BOX 1292
LAJOLLA, CA 92038
Phone: (619) 792-9254
Topic#: 93-030 ID#: 93TOP-010
Office: TOP
Contract #: DACA76-93-C-0011
PI: Jonathan T. Hujsak
Title: A Content Based Texture Pattern Retrieval System with Relevance Feedback
Abstract: This project is designed to produce a design for a significantly new capability for storage and retrieval of texture map data. The proposed retrieval system will incorporate advanced texture classification techniques for automatic indexing of texture images through computation of image feature vectors. The system will provide for texture similarity searches utilizing fuzzy matching of feature vectors. The user will be able to rank retrieved images according to their relevance and initiate automatic adjustment of the texture image query vector according to the relevance judgments of the samples. Relational database search capability will be provided for storage and indexing of coding attributes for the texture images including author, data, agency, associated DFAD feature attributes and other data. Full text searchable capability will be provided for annotation of individual texture records with algorithms descriptions, application details and other pertinent textual data. A POSIX compliant operating system will be assumed for the host which is consistent with state-of-art UNIX based simulation, mission planning, rehearsal and tactical planning workstations. An easy to learn point-and-click graphical user interface will be generated which will be compatible with the X-11 based Open Look and Motif operating environments as well as newer variants such as Windows NT.

PHOTONICS RESEARCH, INC.
350 INTERLOCKEN PKWY., SUITE 245
BROOMFIELD, CO 80021
Phone: (303) 465-6497
Topic#: 92-120 ID#: 92HDL-005
Office: HDL
Contract #: DAAL02-93-C-0026
PI: Jack L. Jewell
Title: Two-dimensional Microlaser Smart Pixel Arrays for Optical Signal Processing
Abstract: We propose to develop compact, high-speed, highly-functional III-V semiconductor optoelectronic modules optimized

for implementation into optical signal processing (OSP) systems under development at government and university laboratories. The modules will be based on vertical-cavity surface-emitting lasers integrated discretely or monolithically with other optoelectronic or electronic circuitry. This technology has the attributes sought for OSPs: compactness, high speed, low power, high gain, high contrast, versatility, robustness to environmental changes, simple implementation into systems, and reconfigurability. The principle and co-investigators will utilize their extensive pioneering experience in this technology, optimizing the designs for analog systems such as image processing and neural networks. Close interaction with groups presently working on OSPs will insure utility for systems under development. Objectives are: 1)evaluate the usefulness to OSPs of device configurations; 2)determine the performance limits; 3)identify potential users of the technology; 4)identify the optimum module; 5)develop a fabrication process for the module; and 6)develop a Phase II project plan to demonstrate and deliver 2-D arrays to HDL and arrange financing to bring components to commercial availability. Photonic Research Inc. has successfully introduced another SBIR-sponsored technology to the commercial market.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
TORRANCE, CA 90501
Phone: (310) 320-3088

Topic#: 93-019 ID#: 93MIC-122
Office: MICOM
Contract #: DAAHO1-93-C-R312
PI: Mark Foster

Title: Non-transmissive Bacteriorhodopsin Spatial Light Modulator

Abstract: Physical Optics Corporation proposes to demonstrate an innovative spatial light modulator (SLM), based on a proprietary optical technology and bacteriorhodopsin (br) thin films, that promises to significantly outperform any commercially available SLM. In the proposed SLM, light does not transmit through the bacteriorhodopsin film, distinguishing it from all of the br SLMs demonstrated to date. Because of this, POC's SLM design eliminates the need for ultra-high optical quality br films. Our technology also requires much thinner br films (5 micro meters as compared to 100 micro meters required for conventional br SLMs), which simplifies fabrication and reduces cost. POC proposes to investigate the use sol-gel techniques to fabricate the bacteriorhodopsin films used in the proposed SLM, enabling the br molecules in the films to be surrounded by a moist, proton rich, pH buffered environment. This type of film promises desirable optical properties and many useful read/erase cycles. The proposed SLM also promises >25 KHz frame rates, >30 dB dynamic range, continuous grey scale, small pixel sizes (<10 micro meters), high optical fidelity, and simple fabrication and optical addressing.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
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Phone: (310) 530-1416

Topic#: 93-023 ID#: 93ARO-001
Office: ARO
Contract #: DAAH04-93-C-0047
PI: Dai Hyun Kim, PhD

Title: A Highly Functional Decision Paradigm Based on Nonlinear Adaptive Genetic Algorithm

Abstract: Physical Optics Corporation (POC) proposes to develop a new computer paradigm which will provide complex, high-dimensional decision capabilities. POC's innovative decision system will incorporate a parallel genetic algorithm (GA) which will incorporate many features of human intelligence. This algorithm will be used in conjunction with an evolved neural network using quantum optical computing. This will be the first computer that combines quantum indeterminacy and Bayes decision making in a significant manner. POC's decision system will be capable of fast adoption, which will greatly increase its range of applications. The optical processors will be clonable, but like humans, they can evolve differently, depending on what characteristics are needed for individual applications. This ground breaking approach will result in a new type of processor that will far outdistance any current computers in such parameters as speed, power consumption, application flexibility, adaptability, and trainability.

PHYSICAL OPTICS CORP.
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Topic#: 92-036 ID#: 92EW -008
Office: CECOM
Contract #: DAAB07-93-C-U766
PI: Mr. Lev Sadovnik

Title: A Small, Signel Block Laser Coherence Discriminator

Abstract: The problem of low-power CW laser detection is not in detector sensitivity but detector selectivity. The only reliable laser feature that is not modified by propagation through the atmosphere is its temporal coherence. Based on this, Physical

Optics Corporation (POC) proposes to develop and fabricate a new type of coherence discriminator that is capable of detecting the presence of low-power laser illumination against a background of much brighter natural and man-made incoherent light sources. This is achievable because only temporally coherent radiation will be modulated and consequently, synchronously demodulated by the proposed coherence discriminator. The proposed device would be usable in all spectral bands of interest. The sensor itself is expected to be rugged, small (< = 8 inches 3), lightweight (< = 200 grams), and inexpensive to fabricate. Thus, a proliferation of devices could be placed on the surfaces of tactical platforms, and eventually, the device concept could be incorporated into "smart skin" designs. In Phase I of this program, a breadboard model of the proposed laser discriminator for the IR spectral region will be built, and its high discrimination capability will be proved experimentally. In Phase II, two field testable prototypes will be fabricated.

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Phone: (310) 530-1416

Topic#: 92-047 ID#: 92CRD-006
Office: CRDEC
Contract #: DAAA15-93-C-0020
PI: Z.Z. Ho, PH.D.

Title: A Generic Bio-alarm Based on the Application of Immunowaveguide and Neural Networks

Abstract: It is frequently the case that a biological alarm is required to provide GO/NOGO information for a user to make a decision in a minimum amount of time. That means bio-alarms should have the ability to identify a large number of biological agents, monitor the change in concentration of these dangerous materials, and make intelligent decisions in a very short time. In response to the need for this technology, Physical Optics Corporation (POC) proposes to develop a generic bio-alarm with selectivity, speed, and sensitivity. The POC approach is based on the combination of two state-of-the-art technologies: waveguide fluoroimmunoassay (WFIA) and artificial neural networks (ANN). The proposed WFIA can have many parallel channels and large sensing areas for simultaneous multiple analytic sensing. ANNs have been applied to various pattern recognition, classification, and intelligent decision making tasks. Both techniques have been independently investigated and have been proven to work. The merger of these technologies will provide the framework for the construction of a biological agent monitor that meets the Army's requirements. POC proposes an innovative and technically unparalleled concept for a highly sensitive fluoroimmunoassay device for biological agent monitoring.

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Topic#: 92-049 ID#: 92CRD-031
Office: CRDEC
Contract #: DAAA15-93-C-0014
PI: Mr. Mark W. Foster

Title: Handheld Surface Plasmon Resonance Biosensor with Replaceable Sensing Cartridge

Abstract: Advances in biochemical warfare technology have necessitated a commensurate advancement in biosensor technology in order to detect the presence of military biological agents in the field. During the past five years, immunosensors utilizing surface plasmon resonance (SPR) have received substantial attention for use in both civilian and military biosensing applications. Physical Optics Corporation (POC) proposes to develop a novel handheld surface plasmon resonance biosensor using a replaceable "multibounce" waveguide sensor cartridge. The waveguide sensor alleviates the requirement of using a prism coupler and rotation stage for SPR measurements. By slightly focusing the waveguided light, the entire surface plasmon resonance is probed passively without any angular adjustments. A simple detector array can be used to monitor the resonance profile and changes arising from the presence of target bioagents. The sensor uses multiple reflections at the sensor interface to increase sensitivity to small amounts of target analysis. The proposed detection scheme allows the possibility of sensing multiple bioagents simultaneously with a single sensor unit. Using POC's "substrate mode" waveguide sensor, well-developed immunoassay thin film chemistries currently used with TIR prisms can be directly incorporated in the miniaturized SPR system.

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Topic#: 92-065 ID#: 92NAT-011
Office: NATICK
Contract #: DAAK60-93-C-0032
PI: Dr. Vladimir Manasson

Title: Helmet-mounted Fiber Optic Emitter For Individual Soldier Identification

Abstract: Physical Optics Corporation (POC) proposes a fully integrated soldier identifier based on a "leaky" emission optical

fiber (i.e. thread) interlaced into a soldiers combat uniform. A low power, battery operated infrared (IR) light source provides the optical fiber pattern detection from all angles and required distances by ground-based night vision devices. In order to minimize possible interception and counterfeiting, the identifier will have an option of remote activation in a pulsed regime. A short emitted pulse will be unnoticeable by an enemy's IR vision device but will be reliably detected by the designated observer due to synchronous framing. The identifier will be made of inexpensive and commercially available parts. Only minor modification is required for the night vision device in order to perform synchronous detection. The Phase I part of the program will deliver a fully operational identifier prototype and IR detection system.

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Topic#: 92-149 ID#: 92TOP-052
Office: TOP
Contract #: DACA76-93-C-0004
PI: Mr. Jeremy Lerner

Title: Smart Environmental Monitor Based on Neural Networks and Multi-specked Pattern Recognition

Abstract: Accelerating industrialization has caused an increasing demand for environmental monitoring. Because of this, physical Optics Corporation (POC) proposes to develop a novel real-time Smart Environmental Monitor (SEM), utilizing a novel Holographic Optical Neural Network (HONN) recently developed at POC for pattern recognition applications. These new architectures combine an optical implementation of the so called N4 neural network architecture, high efficiency compact holographic memory matrices, and new fast electronic algorithms for feature extraction and statistical data analysis. The proposed system will be extremely fast and highly rugged. It will be capable of detecting various contaminants simultaneously with extremely high resolution and sensitivity. POC's HONN can also be made compatible with imaging and mass spectrometers. POC's HONN system can be further expanded in Phase II to contain 64,000 fully interconnected neurons, with over 4x10 9 interconnections. POC's HONN will be capable of "learning" over 20,000 features of different spectral patterns and perform real-time spectral analysis and classifications. The success of this project will result in the most advanced level of a field deployable multi-spectral detection technology.

PHYSICAL SCIENCES, INC.
20 NEW ENGLAND BUSINESS CENTER
ANDOVER, MA 01810
Phone: (508) 689-0030

Topic#: 92-169 ID#: 92SDC-003
Office: SDC
Contract #: DASG60-93-C-0001
PI: William J. Marinelli

Title: Temporal and Spatial Beam Diagnostics for High Power Lasers

Abstract: A novel, non-intrusive technique is proposed for the temporal and spatial imaging of high-intensity infrared laser beams. The technique employs a visible probe laser to excite phosphorescence in a gas seeded into a flow of N2. The high intensity, IR laser beam passes through this gas jet flow. Irradiation of the emitting gas by the IR laser causes a reduction in emission proportional to the laser intensity. Cylindrical optics are employed to define an emitting sheet in a plane transverse to the IR laser beam. This emission is spatially resolved using a image-intensified TV camera synched to the probe laser to obtain the laser beam intensity profile. The temporal resolution of the device is defined by the emission lifetime of the gas of approximately 1 ms with a framing rate of 30 Hz. Commercially available image processing software may be employed to provide real-time diagnostic capability and images may be stored on standard video tape for post-processing. The proposed beam diagnostic technique is directly applicable to target plane beam diagnostics requirements at the High Energy Laser Systems Test Facility (HELSTF) in the various test areas. It will provide the accuracy and the reliability needed to make high quality, rapid target plane beam diagnostics a reality.

PHYSICS & ENG. RES. (PER)
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Topic#: 93-021 ID#: 93TEC-016
Office: TECOM
Contract #: DAAD05-93-C-0189
PI: Avner Amir

Title: Vehicle Magnetic Signature Image Enhancements

Abstract: Several algorithms are proposed to perform the reconstruction and display of the magnetic field lines of the distorted earth filed due to a moving armored vehicle. These algorithms address the problems of defining a "vehicle frame", stationary with respect to the vehicle, and the basic interpolation scheme of the field. Test of the results will be performed using an

available boundary-elements code. A detailed analysis of the sensitivity of the filed STO geometrical details of the vehicle, the practical limits of resolution and the effects of various errors due to the sampling rate and the order of approximations involved, will be performed.

PLASMATRON COATINGS & SYSTEMS, INC.
1704 TAYLORS LANE, TAYLORS LANE BUSINESS CENTER
CINNAMINSON, NJ 08077
Phone: (609) 786-3399

Topic#: 92-028
Office: CECOM
Contract #: DAAB07-93-C-B001
PI: Dr. Ravi Rastogi

ID#: 92C3-010

Title: Method for Advanced Production Techniques for In-line Deposition of Diamond Scratch Resistant Coatings on Optical Glass Fibers

Abstract: We propose a SBIR Phase I project to develop and demonstrate the technology for coating optical glass fibers with a hard, hermetic and chemically inert and scratch resistant layers of Diamond-Like Carbon (DLC). The DLC coatings will provide improved reliability and performance, and maintain the design and dimensional characteristics of the optical fibers against the abrasion, chemical erosion and environmental degradation. DLC layers are inert, moisture and H2 impermeable and will be applied at near room temperature. The DLC films will be applied on commercially available optical glass fibers by magnetically enhanced plasma chemical vapor deposition using an innovative high-intensity cylindrical magnetron reactor developed and pioneered by Plasmatron Coatings and Systems, Inc. Systematic investigations of (i) dependence of hermeticity, (ii) adhesion of DLC to the fiber, (iii) hardness, (iv) scratch resistance and (v) optical and micro-bend losses as a function of microstructure, structure, composition and process parameters will be performed to achieve the proposed objectives. Different layer configuration of DLC films will be studied in Phase I. The cylindrical magnetron reactor, studies in Phase I will be scaled-up to produce an in-line, high-rate, deposition system for coating optical fibers during manufacturing in Phase II.

POLHEMUS LABORATORIES, INC.
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CAMBRIDGE, VT 05444
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Topic#: 92-011
Office: AVSCOM
Contract #: NAS1-19985
PI: Wm. L. Polhemus

ID#: 92AVS-052

Title: A Head-coupled Visual and Aural Sensor System for Teleoperated Rotorcraft Research Vehicle

Abstract: Inside Out vs Outside In! It seems reasonable to hypothesize that the pilot of an air vehicle will feel more in harmony with the actions of his vehicle when he is at the relative "origin" of the coordinate frame of reference of that vehicle ... and will respond more quickly and with greater accuracy, precision, and efficiency. Experience teaches that this occurs for a pilot when utilizing an "inside-out" configuration of cues which square with his physiological sensations. Our goal is to supply those cues utilizing the visual and aural stimuli acquired by appropriate placement of a stereo camera and directional microphone array. A customized version of Polhemus Laboratories binocular, color, high resolution, head-worn display (Looking Glass) system, modified to include a six DOF head tracker and stereo audio system will be provided as the key components of the forthcoming FFRRV ground-based Virtual Cockpit. A PLI Eyeglass display was delivered to NASA-ARC on 16 June '92 for integration with teleoperated camera platforms mounted on an unmanned vehicle. The head tracker (there are three candidates) will supply orientation commands to cameras mounted in the FFRRV, and will be an interactive component in the isolation or confirmation of significant aural cues.

PRINCETON MICROWAVE TECHNOLOGY, INC.
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PRINCETON JUNCTIO, NJ 08540
Phone: (609) 586-8140

Topic#: 92-110
Office: ETDL
Contract #: DAAL01-93-C-3308
PI: Sarjit Singh

ID#: 92ETD-038

Title: Low Cost Microwave/Millimeter-wave Drop-in Ferrite Components

Abstract: The recent advent in Personal Communications Networks, PCN, and Cellular communications has demanded low cost ferrite components for the RF front ends operating at 9GHz cellular and 1.8GHz GSM bands. The thrust of personal communication is now being directed towards other ISM (instrumentation, scientific and medical) bands which allow unlicensed operation at frequencies of 2.4GHZ, 5.8GHz, and 39 GHZ. Additionally licensed cellular systems are being developed at 28GHz. The theme, and reality, for the success of such system is low cost components which are amenable to production methods for mass manufacture. The 28 GHz and 39 GHz cellular systems will operate in large cities where reflections from

large buildings and structures will enable long distance inter-city communications using very small antennas. Ferrite components, such as circulators and latching circulators are used in the front-ends of two way communication systems. The requirement of low cost and high performance demand ferrite components in formats that utilize minimum parts, surface or drop in mounting, small size and minimum interference with interface with other transmission medium. Princeton Microwave Technology, a microwave component manufacturer, and Xtalonix, a microwave ferrite material manufacturer, are proposing to address the low cost manufacture of ferrite components by using novel injection molding methods. The original ferrite components, developed by ETDL, will be prototyped in Phase I using isostatic and hot pressing methods and the ferrite material optimized for high performance. The Phase II plan will then advance the manufacture of the low cost components using state of art injection molding methods and will directly address the forthcoming communication markets that are fast emerging.

PRINCETON SCIENTIFIC INSTRUMENTS, INC.
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Phone: (908) 274-0774
Topic#: 92-174 ID#: 92SDC-056
Office: SDC
Contract #: DASG60-93-C-0010
PI: John L. Lowrance
Title: Improved Visible Image Sensor
Abstract: This proposal is to develop a back illuminated Charged Coupling Device solid state image sensor with improved quantum efficiency in the ultraviolet as well as the visible. The high quantum efficiency that can be attained with back illuminated CCDs, combined with the low readout noise at fast frame rates, makes it possible for this unintensified CCD to replace and improve on the performance of image intensifier-CCD image sensors currently used for low light level imaging and star trackers and faint target acquisition in ASAT systems. This CCD will allow smaller and more reliable cameras to be made. Eliminating the image intensifier results in longer term storage reliability, higher spatial resolution and broader spectral response. Developing this CCD for ASAT also presents a significant commercial opportunity in the area of low light level cameras needed by law enforcement night vision, industrial surveillance and scientific research.

PRODUCT DEVELOPMENT ASSISTANCE, INC.
13511 EAST BOUNDARY ROAD, SUITES D & E
MIDLOTHIAN, VA 23112
Phone: (804) 744-0604
Topic#: 92-045 ID#: 92CRD-039
Office: CRDEC
Contract #: DAAA15-93-C-0009
PI: Rajan A. Jaisinghani
Title: High Efficiency Low Pressure Drop Electrostatic Enhanced Filtration for NBC Aerosols.
Abstract: An Electrostatic Enhanced Filtration (EEF) technology is proposed for NBC collective protective systems such that the efficiency of the current NBC filter medium can be enhanced to at least 99.997 at 0.3 micron, without any increase in the pressure drop of the current medium. This technology also has the potential to kill bacterial components of the aerosol, and possibly also viruses. On the other hand, some amount of ozone is generated by the process (which can be reduced by optimizing the electrode and field configurations). This is a feasibility study, aimed at establishing the required design parameters (e.g. field strength, and electrode geometry) such that the efficiency enhancement is maximized and the ozone production is minimized. A 500-1000 SCFM prototype will be constructed and evaluated for efficiency and pressure drop. The effect of the minimized ozone production on ventilation requirements to meet NIOSH standards for ozone, will also be established by means of a material balance model (Jaisinghani et al. 1989). Additionally, a preliminary evaluation of the effectiveness of the device in terms of killing bacteria, will be conducted.

PSR SERVICES, INC.
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WSMR, NM 88002
Phone: (505) 678-9365
Topic#: 92-094 ID#: 92TEC-016
Office: TECOM
Contract #: DAAD07-93-C-0113
PI: Jimmy D. Shirley
Title: Modular Laser Beam Analyzer
Abstract: PSR Services, Inc. (PSRS) proposes to develop and demonstrate a concept for a High Resolution Laser Target Plane Image Analysis System to measure laser beam near and far-field intensities, total power, jitter, divergence, and quality. Primary device features include: (1) a modular scalable sensor area, (2) a wide spectral range, (3) full-frame data capture, (4) variable integration time and frame rate, (5) real-time beam diagnostics, (6) portability, (7) suitability for mobile/airborne applications, (8) built-in diagnostics, and (9) calibration simplicity.

QUEST INTEGRATED, INC.
21414-68TH AVE. SOUTH
KENT, WA 98032
Phone: (206) 872-9500

Topic#: 92-095 ID#: 92TEC-018
Office: TECOM
Contract #: DAAD01-93-C-0048
PI: Dr. H.-T. (Peter) Liu

Title: 3-D Radiography and Image Analysis of Defect Detection

Abstract: In Phase I of this project, we will investigate the feasibility of adding a "real-time" or "near real-time " stereoscopic imaging capability to the armaments radiographic inspection system already in place at Yuma Proving Ground. We will determine the best way to implement rapid, accurate, and cost-effective automated stereoscopic inspection with minimal modifications to existing equipment. We propose to do this by (1) providing a stereoscopic imaging demonstration on a PC-type computer with a stereo-scoping display, (2) using this demo to obtain stereo radiographs of Yuma's actual test items in the context of the ultimate automated system, (3) analyzing the configuration and capabilities of the present facilities (which include the radiographic systems and the image processing computer system) to determine the best way to take the necessary multi-aspect radiography, and (4) determining the functional requirements of the ultimate system (with respect to, for example, image quality and resolution, throughput, the need for image processing and measurements, and operator ease of use). Phase II would implement such a system at the Yuma Proving Ground. We look forward to taking this technology to the broader industrial inspection community in Phase III.

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Topic#: 92-104 ID#: 92ASL-007
Office: ASL
Contract #: DAAL01-93-C-2011
PI: Dr. Paul A. Hwang

Title: Size Distribution and Number Density of Airborne Particles Near the Ground Level -- Vertical Distribution and Wind Speed Dependence

Abstract: To enhance characterization of the propagation path of assorted Army electro-optical and electro-acoustic devices, a detailed understanding of atmospheric conditions near the ground surface is needed. This proposal concentrates on the effects due to the presence of airborne particles. The ground-level aerosol model currently implemented is rather crude and needs to be refined. In the proposed study, the generation of airborne particles from local soil sources will be investigated theoretically based on our understanding of turbulence diffusion and sediment transport processes. The results will allow us to evaluate the error in estimates of aerosol number density due to the negligence of the vertical gradient and wind dependence close to the ground. Building upon this theoretical framework, as well as field data assimilation, we will establish an aerosol model for the lower boundary layer that contains explicit functional dependence of the elevation and wind speed. The new aerosol model will be used for extinction and scatter computations, which will enable enhancement of the performance of optical and acoustic sensors in ground-level applications. The computation of extinction, visibility, transmission attenuation, target acquisition probability, image obscuration, and image resolution will be improved through more accurate estimation of the number density and size distribution of airborne particles along ground-level propagation paths.

RADAR GUIDANCE, INC.
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SAN ANTONIO, TX 78229
Phone: (214) 250-0334

Topic#: 92-057 ID#: 92MIC-020
Office: MICOM
Contract #: DAAHO1-93-C-R019
PI: Aubrey I. Chapman

Title: Low Cost, LPI, All Weather, Automated Optical Microwave Technology for IFF of Unmanned Aerial Vehicles (UAV)

Abstract: RGI proposes to demonstrate through analysis the feasibility of using modified versions of the proven OMAR (Optical Microwave Approach and Ranging) technology to enhance the reliability and survivability of UAV's by using the OMAR technology for UAV, IFF, tracking and flight commands for evasive action when necessary. OMAR, currently under development as a low cost, stand alone, precision, all weather landing system for VTOL aircraft lends itself uniquely to these UAV requirements. Modifications to the existing OMAR design will be required for this specialized UAV use but basic concepts of Luneberg lens beam shaping with angle/range processing will remain valid. Basic OMAR characteristics, include the ability to operate in a passive (covert) mode, which makes it attractive as a portable 3-dimensional military IFF, positioning, tracking and command system with many commercial applications. For UAV applications: response to authentication coded interrogation, structured in directional low-power reflective needle beams and provides a low probability of intercept and a positive identification of friend or foe (IFF) for unsophisticated, lethal and unmanned aerial vehicles. It's small, all-weather, unique

operational characteristics make it possible for OMAR to monitor more than 50 IFF targets and provide its 3-dimensional positioning information in digital form into Intel networks such as the NOMAD and SAMURAI systems and/or Patriot Missile System in real time.

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SAN JOSE, CA 95117
Phone: (408) 345-4900
Topic#: 92-040 ID#: 92SW-012
Office: CECOM
Contract #: DAAB10-93-C-0020
PI: Brian G. Agee
Title: Robust Techniques for Acquisition and Processing of PH, PH/DS and Conventional Communications Signals
Abstract: An SBIR project is proposed to apply optimal detection and estimation theory to acquisition (detection/classification), copy, and localization (DF) of frequency agile, hybrid FH/DS, and conventional telecommunications signals. A two-stage baseline system is proposed to accomplish this, consisting of a multisensor processor front-end, which employs dominant-mode prediction (DMP) and polychannel DMP (PC-DMP) to detect, copy, and localize emitters on the basis of their variation in time-frequency support (temporal burstiness and/or bandwidth extent); and a signal-sensor processor back-end, which employs log-likelihood functions (LLFs) and per-survivor-processing (PSP) algorithms to classify and demodulate the dehopped/downconverted emitters provided by the processor front-end. Both stages provide optimal (GLRT) statistics for detection and classification of the emitter waveforms, and provide optimal (ML) estimates of the emitter waveforms under appropriate modelling conditions. In addition, the baseline processor is compatible with channelized digital reconnaissance systems under current development, such as the TACJAM A system, in that they can operate against emitters with bandwidths larger than the frequency channelization of the reconnaissance system, even if that system employs undersampled frequency channelizers that do not allow complete regeneration of the emitter time series

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Topic#: 92-173 ID#: 92SDC-045
Office: SDC
Contract #: DASG60-93-C-0009
PI: Peter P. F. Radkowski III
Title: Proof-of-Concept of Innovative Soft-kill Pellets
Abstract: Radkowski Associates has developed an innovative soft-kill concept that offers to significantly enhance kinetic energy lethality against satellites. The proposed research effort would use advanced modeling, material fabrication, and gun range testing to prove the Soft-kill Pellet Concept. Advanced hydrocode calculations of conceptual design performance indicate that, in comparison to other kinetic energy kill devices, the Soft-kill Pellets offer significant performance enhancements, including: 1. Lethal diameters are increased by a factor of two (or more); 2. Orbital space debris is significantly decreased (or eliminated); 3. Mechanisms are included for enhance sensor-detection of lethal impact; 4. Fabrication and deployment costs are low; and 5. Safety and durability are increased. The Soft-kill Pellets can be deployed singularly or as clouds by a variety of kill vehicles.

REDZONE ROBOTICS, INC.
2425 LIBERTY AVENUE
PITTSBURGH, PA 15222
Phone: (412) 765-3064
Topic#: 92-143 ID#: 92CER-044
Office: CERL
Contract #: DACA88-93-C-0008
PI: Chris Fromme
Title: In Situ Tank Inspection System (ITIS)
Abstract: RedZone Robotics, Inc. proposes to develop a system capable of performing automated inspections on a variety of underground storage tanks (UST) configurations. The system will consist of the following parts: 1) manipulator/mechanism for sensor delivery; 2) collision avoidance sensing; 3) force or other feedback sensor for proper sensor placement; 4) computer feedback and control; 5) software for automated inspection/data gathering. The objectives of the Phase I efforts are to develop a suitable mechanism which can be deployed into a variety of different UST configurations. Also, the sensing system used to determine the robot's location within the tank is a key technology which must be adapted from current techniques. A prototype of the mechanism will be built to prove the selected concept. After testing on a UST mock-up, the design will be refined and modified with the goal of providing a hardened design. Phase II and III will be used to develop the controller to drive the system and develop custom software and procedures for performing inspections.

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Phone: (617) 576-8611
Topic#: 92-158 ID#: 92MED-046
Office: MEDICAL
Contract #: DAMD17-93-C-3090
PI: Dr. Kittie Murray
Title: A Test Device for Organic Pollutants at the Low PPB Level
Abstract: We propose to develop a test vice for the measurement of trace organic materials in water. The device is specifically targeted at the analysis of hei ides and pesticides in water. The target level of detection is the low part per billion concentration range for materials with a molecular weight of about 300. The approach is a modification of a commercially available medical diagnostic test. The modification consists of a proprietary amplification method that will increase sensitivity while not sacrificing the original ease and convenience of use. The test will require no user operations except to place the device in the sample. The readout will show either a positive or negative response where positive represents a level above a set concentration. This will be the EPA limit or others specified by the DoD. The device should be stable for many years at room temperature.

RESEARCH & DEVELOPMENT LABORATORIES
5800 UPLANDER WAY
CULVER CITY, CA 90230
Phone: (310) 410-1244
Topic#: 92-108 ID#: 92ETD-017
Office: ETDL
Contract #: DAAL01-93-C-3305
PI: ERIK Unit
Title: Suppression of Vibration-induced Sidebands
Abstract: Study and define the feasibility and the possible improvements from the suppression of vibration-induced sidebands in crystal oscillators. Task A: Study and define an optimal design for obtaining the sum and difference frequencies from two nominally identical SC-cut crystal oscillators appropriately arranged with respect to each other so as to obtain maximum cancellation of steady-state acceleration sensitivities. Task B: Study and design an analog circuit to use the information in the difference frequency to obtain optimal correction of the sum frequency. Task C: Study and define A/D and D/A converters to support digital compensation. Study the impact of clock instability on conversion accuracy. Task D: Study and define digital compensation schemes. In particular study the adequacy of using the crystal oscillator to compensate for the digital processing clock.

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Phone: (315) 455-7157
Topic#: 92-175 ID#: 92SDC-076
Office: SDC
Contract #: DASG60-93-C-0012
PI: George Millman
Title: Improved Real-time Ionospheric Compensation for Kwajalein Missile Range (KMR) Radars
Abstract: The objective of this study is to identify an ionospheric model for improving, in real time, the ionospheric propagation error corrections for the ARPA long range tracking and instrumentation radar (ALTAIR) located at the Kwajalein Missile Range (KMR). The study consists of: (1) performing a state-of-the-art review of the various ionospheric models; (2) designating an ionospheric model for ALTAIR based on low-latitude transionospheric propagation comparison of the various ionospheric models; (3) comparing the selected model with the present ALTAIR ionospheric model and with the electron content data recorded at KMR; (4) identifying the ionospheric measurements which should be conducted at KMR prior to incorporating the ionospheric model in ALTAIR; and (5) assessing the potential use of the ionospheric model at other geographic locations.

RESEARCH DEVELOPMENT CORP.
11835 COOPERS COURT
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Phone: (703) 391-0156
Topic#: 93-022 ID#: 93STR-009
Office: STRICOM
Contract #: M67004-93-C-0083
PI: Dr. John Leddo
Title: Simulator/Simulation Based Intelligent Tutoring Systems (ITS)
Abstract: Intelligent Tutoring System (ITS) show promise for improving the efficiency of teaching by providing one-on-one instruction and tailoring that instruction to each student's needs. Simulators/simulations are effective training tools because they provide practical problem solving experience in a realistic environment. Unfortunately, a gap exists between these two technologies in that most ITS researchers have not focused on a simulator/simulation environment, while most

simulator/simulation efforts have not incorporated ITS technology. The proposed work would integrate these two technologies by developing an ITS framework that could incorporate simulators/simulations. The ITS's instructional framework would be based on a cognitive science model of expert problem solving and how to build such skills in students. This model would then drive the types of simulations that students would interact with. Students' responses on the simulations would then be evaluated by the ITS to determine what students have learned and what additional instruction is needed (which then iteratively drives the simulation.) Phase I has two research goals: 1) to develop an instructional framework based on models of expert problem solving that is suitable for incorporation in a simulation environment; and 2) develop a simulation-based ITS.

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FAIRFAX, VA 22033
Phone: (703) 620-5385
Topic#: 93-010 ID#: 93SE -019
Office: CECOM
Contract #: DAAB07-93-C-Q008
PI: Ruben Prieto-Diaz
Title: DSSR: Support for Domain Specific Software Requirements
Abstract: Reusable software requirements offer significant potential for rapidly producing high quality software systems within many application domains. This is particularly the case in application domains where many variations of similar systems are generated. Command and control systems, such as those in CECOM, are especially good examples. Reusable requirements need to have the following properties. They must use standard domain-oriented vocabularies, they must identify the common requirements to all systems in the family, and they must identify the portions of the requirements that vary between different system variations. In addition those variations must include rationale for choosing them over the other alternatives, including tradeoff and risk assessment information. Such requirements should be catalogued using techniques such as faceted classification, be composable, and be easily extended. This a proposal to assess the current state of requirements reusability and define a requirements methodology and set of tools that foster requirements reuse. The proposed requirements method will stress techniques for constructing and reusing requirements, such as domain analysis, OOA, and issue-based techniques. As part of the Phase I objectives, we will also define an architecture for an environment to support the methodology and promote automated requirements reuse.

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Phone: (714) 557-6180
Topic#: 92-147 ID#: 92TOP-022
Office: TOP
Contract #: DACA76-93-C-0002
PI: Robert W. Levi
Title: Personal Navigation and Reporting
Abstract: Troop movements in the battle field must be done precisely to achieve combat objectives. Modern weapons can be accurately targeted, but to prevent "friendly fire" accidents, actual troop positions must be known by commanders precisely with a high degree of confidence. Combining GPS with advanced dead reckoning sensors, a data link, digital map technology and a microcomputer would provide the soldier with a reliable position finding means and the capability to relate his position to others. The proposed project will develop a compact man-portable, soldier navigation and reporting system that is not wholly dependent on one navigational aid such as GPS. The system will provide the capability for uniquely identifying and tracking a virtually unlimited number of troops without pre-arranged synchronization or prior knowledge of troop positions. Concepts for several unique sensors that will aid dead reckoning for the foot soldier are discussed. The proposed project represents extensions of ideas based on previously developed position location transponders and our experience with navigation systems.

ROCHESTER PHOTONICS CORP.
80 O'CONNOR ROAD
FAIRPORT, NY 14450
Phone: (716) 377-7990
Topic#: 92-122 ID#: 92HDL-034
Office: HDL
Contract #: DAAL02-93-C-0019
PI: Dr. John P. Bowen
Title: Laser Pattern Generator for the Fabrication of Diffractive Optical Elements
Abstract: A single-point laser writing system for the fabrication of multi-phase level surface-relief diffractive optics will be designed and analyzed. The instrument will be designed to generate diffractive structures in photoresist. The minimum feature size obtained from such an instrument directly influences the maximum diffraction angle, wavefront performance, and diffraction efficiency of the resulting optical element. The overall performance of the optical element is a strong function of the instrument

accuracy. In the Phase I research and development effort, a user interface and the associated software routines for developing generalized phase structures will be developed. Optical elements of interest include diffractive lenses and interconnect distributions for optical processing applications. Compared to electron-beam or VLSI-lithographic methods, a laser offers the potential for small feature sizes at reasonable cost. Direct writing on the substrate will allow the optic to be manufactured at one station. The goal of the SBIR Phase II development effort is to construct and evaluate an integrated workstation for the fabrication of a wide range of diffractive components.

S.R. TAYLOR AND ASSOC.
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Phone: (918) 333-7502
Topic#: 92-066 ID#: 92NAT-027
Office: NATICK
Contract #: DAAK60-93-C-0029
PI: Dr. Scott Taylor
Title: Novel Ultrasonic Method for Food Dehydration
Abstract: Foods are dehydrated to make them more easily packaged and stored at room temperature. The removal of water reduces the opportunity for harmful chemical reactions. Dehydrated food powders and particles are also used in "liquid meals" for dental patients. However, dehydrated foods traditionally have been difficult to rehydrate and are of relatively poor quality. The reasons for these difficulties are from thermal damage due to the high temperatures necessary to dehydrate the foods. A process useful for heat sensitive foods, which is presently being used by the U.S. Army for their dehydration needs, is freeze drying. Freeze drying, although effective, has its drawbacks. Freeze drying is a very expensive process involving high capital costs and high energy cost. S.R. Taylor and Associates proposes an alternative method to do dehydration for the U.S. Army. Ultrasonic drying has been proven effective for certain types of heat-sensitive materials, such as many fresh foods. Phase I will determine which food-types would be appropriately dried ultrasonically, and at which processing variables. Phase II would involve process optimization for the highest quality dried rehydrated product at the lowest cost. S.R. Taylor and Associates has actively been involved in developing a novel ultrasonic flexural plate design to deliver a highly axisymmetric sound beam into gaseous and liquid media. This unique flexural plate will produce the desired sound wave pattern to enhance food dehydration at unharmful temperatures and conditions.

SAG CORP.
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FALLS CHURCH, VA 22046
Phone: (703) 538-4500
Topic#: 92-153 ID#: 92ARI-006
Office: ARI
Contract #: MDA903-93-C-0094
PI: Lee S. Mairs
Title: Measuring the Costs and Benefits of Army Service
Abstract: SAG Corporation proposes to develop a framework for measuring the economic and social costs and benefits of an Army career. The research will focus on identifying and evaluating data sources and developing quantitative methods and procedures for comparing these costs and benefits. The resulting model will go beyond traditional retention models to look at the total impact of an Army career on an individual's present and future participation in the work force. The Phase I research will explore how costs and benefits vary with occupation, race and gender as well as career length. The research will incorporate elements of econometric and psychometric analysis as well as cost-benefit modeling. Phase I will result in a conceptual model to serve as the foundation for Phase II development of a policy analysis tool that Army analysts can use to objectively evaluate personnel and compensation policies. The model will allow for comparisons involving career lengths and differing assumptions about underlying determinants of the career decision. Costs and benefits will be tracked for an individual's entire career in the labor force.

SAN'DOIL COMPANY
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NEW ORLEANS, LA 70113
Phone: (504) 646-1493
Topic#: 92-163 ID#: 92MED-063
Office: MEDICAL
Contract #: DAMD17-93-C-3093
PI: Dr. Arthur V. Stiffey
Title: Rapid Field Toxicity Test for Water Supplies
Abstract: A patented (U.S. Patent #4,950,594-1990) inexpensive, quick, precise method of testing substances for toxicity has been developed, LUMITOX (R), which measures quenching, in the presence of toxins, of the natural bioluminescence of the abundant marine dinoflagellate pyrocystis lunule. The LUMITOX (R) microbiological assay is a compact laboratory procedure

that has been proven effective on all common toxins tested. Specific applications have included mycotoxins, exfoliates, insecticides, waterbottom sediments (Chukchi Sea), marine anti-fouling paints, and oil-well drilling fluids. The procedure has demonstrated a variation of less than 10%, sensitivity to a few parts per million, and effectiveness in darkly colored and turbid media. At its present stage of development, in the laboratory LUMITOX (R) yields results in a few hours, rather than the days required for existing bioassays. A project is under way to isolate the test organism's operative enzymes in order to develop a field-testing reagent. Design and construction of portable device consisting of a sample chamber, agitator, photodiode, metering circuit (also patented, U.S. Patent #4,689,305-1987), and LED or other readout mode also are necessary to complete a portable field toxicity testing unit, which has obvious potential for both military and civilian environmental applications.

SATCON
12 EMILY STREET
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Phone: (617) 661-0540
Office: AVSCOM
Contract #: NAS1-13827
PI: Richard L. Hockney
Title: Innovative Blade Design Concepts for Highly Maneuverable Rotors
Abstract: Future military rotorcraft will require significant increase in maneuverability and handling qualities with low detectability for air-to-air combat and map of the earth operations. SatCon Technology Corporation proposes to develop innovative blade design concepts using smart material/structures to meet this requirement by substantially enhancing the maneuver capability of the rotor. These concepts, consisting of piezoelectric, electro-strictive, magnetostrictive and other advanced actuators integrated into the blade design, would allow individual control of the rotor blades. This approach will improve operability by improving maneuverability, agility, and speed; improve supportability by increasing reliability; and improve survivability by decreasing signature (noise and vibration). Phase I will identify and compare advanced and innovative blade design concepts using smart materials/structures which enhance the maneuver capability without performance and weight penalties. The most promising concepts which are representative of current future technology will be traded-off considering both benefits and disadvantages in terms of attributes such as rotor performance, weight, and complexity. In Phase II additional evaluation of the most promising concepts will be performed to verify benefits and disadvantages. A 10-ft. diameter scale model of the most promising concept will be fabricated and tested to validate the theoretical predictions.

SATCON TECHNOLOGY CORP.
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Phone: (617) 661-0540
Topic#: 92-019
ID#: 92AVS-106
Office: AVSCOM
Contract #: DAAJ02-93-C-0005
PI: Dariusz A. Bushko
Title: High Bandwidth Magnetostrictive Actuator for Helicopter Electric Flight Control
Abstract: Progress in electric flight control has been hindered by the lack of a high bandwidth actuator. The challenge is to identify an efficient, responsive, and power-dense source of mechanical displacement. Actuators based on "giant" magnetostrictive materials, such as Terfenol, achieve very high magnetic strain (up to 2,000 ppm) and therefore provide power density unmatched in electromechanical systems. They out perform all known piezoelectric materials in terms of mechanical properties. SatCon has used Terfenol in several high performance actuators for space applications. In a large-stroke actuator, however, strain must be amplified while preserving power density. SatCon proposes to demonstrate an innovative actuator which uses local hydraulics to transform magnetostrictive strain into an arbitrarily long stroke. Magnetostriction generates pressurized fluid flow which powers a linear hydraulic actuator. The benefits of high performance hydraulics are retained without sacrificing the weight, redundancy, reliability, and simplicity of electric actuation. During Phase I, SatCon will develop a preliminary actuator design suitable for a cyclic/collective application. During Phase II, SatCon will detail design, fabricate, and bench test the actuator. Specifications will be as stated (3 inch stroke, 25 hp rating, and a response comparable to hydraulics). Alternate forms of electric power will be studied. Air cooling will be maximized.

SATCON TECHNOLOGY CORP.
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Phone: (617) 661-0540
Topic#: 92-023
ID#: 92AVS-157
Office: AVSCOM
Contract #: DAAJ02-93-C-0005
PI: Monique Gaffney
Title: High Power Density Magnetostrictive Reaction-mass Actuator

Abstract: Magnetostrictive materials have been successfully used in single-axis actuator designs to produce forces over 3500 pounds, strains of 1200 ppm, and have bandwidths past 10,000 Hertz. Terfenol-D, the "giant strain" magnetostrictive material is an excellent candidate to produce a high power density reaction-mass actuator for helicopter gearbox noise cancellation. Using magnetostrictives, the single axis actuator can meet the weight, volume and durability requirements, without compromising the force or frequency range specifications. In contrast to piezoelectric materials, magnetostrictive materials have seven times larger strain and fifteen times higher energy density, resulting in more actuation effort for the given mass and volume budget. Unlike piezoelectrics, magnetostrictives do not require high voltages to operate efficiently. Compared with piezoelectrics, magnetostrictives have greater reliability and longer life advantages. The proposed work is to demonstrate the feasibility of using a magnetostrictive driven reaction-mass actuator for helicopter gearbox noise cancellation. During Phase I, the objective is to design, fabricate, test, and deliver a high-force density, magnetostrictive-based reaction-mass actuator. This actuator shall be capable of exceeding the suggested specifications of over 100 pounds at frequencies between 1000 and 4000 Hz. During Phase II, this work will be extended to multi-degree-of-freedom designs.

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Topic#: 92-024 ID#: 92AVS-165
Office: AVSCOM
Contract #: DAAJ02-93-C-0005
PI: James R. Downer, Ph.D.

Title: High Efficiency, Low Weight Electric Inlet Particle Separator (IPS) Blower for a Turboshaft Engine

Abstract: An electric-motor driven Inlet Particle Separator (IPS) blower is an ideal solution to a number of technical problems related to eliminating sand and dust erosion of turboshaft engine components. A motor which does not require liquid lubricant would be even more desirable since the inlet area of turboshaft engines is a difficult one for the installation of lines. SatCon proposes to develop a flux-concentrating permanent-magnet brushless motor and its associated controller as an IPS blower motor. This motor design makes the best use of advanced magnetic materials technology since the total weight and power consumption of components is critical. The electronic interface design will make use of either AC or DC (28 V or 270 V) primary power to determine the optimum approach for minimum size and weight. A maximum weight of five pounds has been established. Oilless bearings based on solid lubricant or an advanced bearing grease will be used. During Phase I, SatCon will generate a preliminary design for the motor and electronic drive system using the T800 engine. During Phase II, SatCon will detail design, fabricate, and bench test the IPS electric blower. Testing will simulate T800 IPS operation over full engine operating range.

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Topic#: 92-080 ID#: 92TAC-035
Office: TACOM
Contract #: DAAE07-93-C-R018
PI: James H. Goldie

Title: The Development of an All-electric Active Vehicle Suspension Based on a Linear Reluctance Machine

Abstract: SatCon Technology Corporation proposes to develop an all-electric vehicle suspension which utilizes a switched linear reluctance machine (LRM) and associated drive and control electronics. The low losses of switched reluctance machines, while operating under high loads and motions of varying direction, suggest that a linear version is uniquely suited for this application. The low losses indicate that it can be compactly packaged into an active suspension relative to other electric actuators without risk of overheating. Combining the LRM with the similar compactness and low loss of pulse width modulation inverters and the flexibility of a DSP-based controller permits development of an all-electric suspension which is compact, reliable, user adjustable, and adaptable to changing road or terrain conditions. Furthermore, the energy absorbed by the proposed suspension system during operation may be recovered rather than dissipated as heat, significantly improving fuel economy. During Phase I Satcon proposes to design a complete suspension system, including the LRM actuator, the drive electronics, and the programmable controller, such that various suspension control algorithms could be easily implemented. In addition, SatCon will fabricate and test a small-scale LEN, to demonstrate the remarkable high force-to-loss ratio of this type of machine.

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Topic#: 92-141 ID#: 92CER-050
Office: CERL
Contract #: DACA88-93-C-0020
PI: Selden Saunders

Title: Development of Vacuum Supported Automated Platform and Method of Paint Removal and Dust Collection
Abstract: The project will develop a unique vacuum supported platform which will automate the process of removal of toxic paint from Army buildings. The platform will traverse wall and ceilings and position the paint removal system for optimum results. A unique dust collection system will be developed to work in conjunction with the platform with high efficiency. The best method of paint removal to use in conjunction with the platform will be determined, so that the system is very cost effective.

SBS ENGINEERING, INC.
18333 EGRET BAY BLVD, SUITE 340
HOUSTON, TX 77058
Phone: (713) 333-5040

Topic#: 92-037 ID#: 92SE -005
Office: CECOM
Contract #: DAAB07-93-C-Q004
PI: Patrick Rogers

Title: An Extended Ada Runtime Environment for Distributed, Fault Tolerant Applications
Abstract: In response to ever-increasing requirements, next-generation embedded systems will typically consist of several physically dispersed uniprocessor or multiprocessor nodes. In order to harness the potential of such architectures, a definition of distributed, fault-tolerant Ada must exist. Because the language standard does not meaningfully address distribution or fault tolerance, an extension of the underlying runtime support environment is both appropriate and cost effective. This proposal outlines initial baselines for the necessary models of distribution, fault tolerance and dynamic reconfiguration, and proposes to refine these models into a preliminary systems architecture design.

SCHWARTZ ELECTRO-OPTICS, INC.
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ORLANDO, FL 32804
Phone: (407) 298-1802

Topic#: 92-035 ID#: 92NV -095
Office: CECOM
Contract #: DAAB07-93-C-U007
PI: Dr. Madhu Acharekar

Title: Non-cooperative Combat Identification
Abstract: Generally, detection and recognition of a target can be made at distances greater than those for positive identification. In an effort to extend the identification range, Schwartz Electro-Optics, Inc. (SEO) proposes to develop a concept for Non-cooperative Combat Identification by sensing the vibrations of targets with Doppler Laser Radar. Vibrational signature measurement with Doppler Laser Radar has been successfully demonstrated using CO2 lasers. Issues of size, cost, weight, and reliability of the laser have prevented deployment of these sensors. Recent developments in two micron solid state lasers can allow vibrational signature measurement in a compact, reliable sensor. Eye-safe operation is maintained at this wavelength, as is the ability to penetrate obscurant and dust on the battlefield. The proposed Phase I effort draws on past and on-going activities at SEO to prove the feasibility of target identification, and to develop a preliminary design of a prototype sensor. The effort will include an analysis and assessment of available signature data, a parametric design study of the sensor parameters, and development of a top-level, prototype sensor design.

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Topic#: 92-092 ID#: 92TEC-041
Office: TECOM
Contract #: DAAD09-93-C-0020
PI: Roger E. Davis

Title: Automatic Smoke and Obscurant Cloud Pattern Recognition from Visible and Thermal Imagery
Abstract: U.S. Army smoke and obscurant field testing programs produce information and data for assessment of inventory and developmental obscurants. Determinations of obscurant cloud dimensions, locations, and centroids are often used for quantifying performance. To determine geometric cloud characterization parameters, current data reduction procedures require time-sensitive and potentially inconsistent manual (human) location of cloud perimeters from visible and infrared video imagery. The Phase I work plan proposes to identify both software and hardware components necessary to create an automated cloud perimeter location system. The plan seeks to integrate human cues into a knowledge base which will utilize image processing techniques and algorithms. The Phase I effort will also explore algorithms for the extraction of additional obscurant information, e.g., path radiance and cloud density, from the video imagery. Successful techniques and algorithms will be recommended for inclusion in the Phase II engineering of the perimeter detection system.

SCIENCE RESEARCH LABORATORY, INC.
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SOMERVILLE, MA 02143
Phone: (617) 547-1122
Topic#: 93-034 ID#: 93MED-076
Office: MEDICAL
Contract #: DAMD17-93-C-3149
PI: DR. ALLEN FLUSBERG
Title: Low-dose, Accurate Screening Instrument to Measure Body Nitrogen and Calcium
Abstract: The objective of the proposed effort is to develop a compact, accelerator-based facility that accurately measures the fraction of nitrogen and calcium in the body. The proposed facility will determine body content of these elements from resonant gamma absorption (RGA) measurements that are element specific. A major application is the routine screening of muscle and bone mass of military personnel, which will allow the establishment of a minimum-muscle-mass standard for new recruits. Low-dose serial nitrogen (muscle) and calcium (bone) mass measurements on troops undergoing rigorous training will also permit a quantitative determination of optimum diet as a function of exercise regimen. In-vivo Neutron-activation Analysis (IVNA) is currently the most accurate technique for quantifying body composition. RGA will achieve comparable or better accuracy in a shorter time period and with radiation doses that are 3-4 orders of magnitude lower than required by IVNA. Unlike elaborate, expensive IVNA facilities, a clinical RGA instrument will be compact and simple enough to be installed in many military medical facility and to be operated by their staff. The proposed Phase I effort is a theoretical effort to design the components of a facility dedicated to making RGA body composition measurements, particularly the 2-MeV electrostatic proton accelerator and its integration with the proton target and the array of gamma-ray detectors. This facility will be developed and demonstrated in Phase II.

SCIENTIFIC AERO MONITORING, INC.
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SCOTTSDALE, AZ 85258
Phone: (602) 991-5577
Topic#: 92-010 ID#: 92AVS-036
Office: AVSCOM
Contract #: DAAJ02-93-C-0002
PI: Dr. Link C. Jaw
Title: Active/Passive Clearance Control for Small Turbine Engines
Abstract: Active clearance control promises considerable improvements in rotating component efficiencies and compressor surge margin. These improvements are essential to meet stringent performance requirements for next generation propulsion systems. The improvements are more pronounced for small engines, because clearance effect in small engines accounts for a bigger portion of rotating component losses than large engines. Scientific Aero Monitoring, Inc. proposes to conduct a research program on active clearance control for a small turboshaft engine. The firm should like to evaluate the feasibility of current and innovative clearance control concepts, and carry out the design, simulation, and demonstration of the most feasible concept in a test rig. The firm should like to focus its research on centrifugal compressors, because it is the preferred type for small turboshaft engines. The firm presented a candidate clearance control system in this proposal, although the candidate control system should not limit the firm's assessment of other feasible control concepts. Scientific Aero Monitoring, Inc. was founded with a vision to utilize the efficiency and concentration of a small business to facilitate technology development and adaptation. The firm emphasizes accountability and goal-oriented work ethics. The investigators for the proposed program offer more than 35 years of combined experience in aerospace system modeling, design, development and testing. A major portion of this combined pool of experience is directly related to the gas turbine engine field.

SCIENTIFIC RESEARCH ASSOC., INC.
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GLASTONBURY, CT 06033
Phone: (203) 659-0333
Topic#: 92-055 ID#: 92MIC-116
Office: MICOM
Contract #: DAAHO1-93-C-R123
PI: Harold L. Grubin
Title: Quasi-Optical Power Combiner Modeling
Abstract: This document describes a program for numerically predicting the performance of hundreds of millimeter wave oscillators that are combined through quasi-optical techniques. The focus of this program will be on combining three terminal field effect transistors. The basis of the analysis centers around the injection locking of canonical oscillators. Among the issues to be addressed during the Phase I are: (1) What is the locking bandwidth of the system of injection locked oscillators? (2) After an initial turn-on transient, how many cycles are needed before the oscillators synchronize to a common frequency and phase? (3) Are there restrictions on the distribution of amplitudes of the oscillators in order to achieve synchronization? (4) How will device and circuit variations influence the locking properties? (5) What constraints are to be imposed to operate the couple-oscillator arrays as mode-locked arrays? (6) Choices of oscillator configurations. (7) Best use of Fabry-Perot resonators.

(8) Limitations on packing density. The out of the calculations will also provide (1) the radiation patterns for a finite set of coupled oscillators, for prespecified values of the coupling phase; and (2) the time dependence of the output signal power envelop of a number of mode locked oscillators.

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SHAWNEE, KS 66216
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Topic#: 93-013 ID#: 93CRD-013
Office: CRDEC
Contract #: DAAA15-93-C-0072
PI: Andrew J. Holder

Title: Development of Semi-empirical Parameters for the Group V and Group VI Elements

Abstract: The project proposed for funding here deals with the expansion of a next generation model in semi-empirical molecular orbital treatments. The new approach is called SAM1 (for Semi-empirical AB Initial Method Version 1). SAM1 is different from present methods in that it explicitly computes two-electron repulsion integrals via a minimum Gaussian basis set, bringing new theoretical rigor to the NDDO model on which such successful techniques as AM1 and MNDO are based. Many of the aspects that make semi-empirical methods so attractive and useful to such a wide audience (i.e. speed and implicit accounting for electron correlation) are retained in SAM1. We propose here to expand and apply the SAM1 method to a variety of new elements and to test its performance on the prediction of chemical phenomena. Parameter sets for carbon (C), hydrogen (H), oxygen (O), nitrogen (N), fluorine (F), chlorine (Cl), bromine (Br), and iodine (I) have already been derived. We will expand this set of elements to sulfur (S), phosphorous (P), silicon (Si), arsenic (As), and copper (Cu), allowing SAM1 to be applied to a wide range of chemistry including the processes of life, materials science, and many reactions of industrial importance. SAM1 represents the first practical and accurate computational treatment of systems involving transition metals.

SENSORS UNLIMITED, INC.
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Topic#: 92-107 ID#: 92ETD-076
Office: ETDL
Contract #: DAAL01-93-C-0268
PI: Dr. Marvin S. Abrahams

Title: "A Merged Hydride/OMVPE Expitaxial Growth System for InGaAsP Alloys

Abstract: We propose to design, construct, and optimize a novel vapor phase crystal growth system for semiconductor optoelectronic devices which combine the best features of organometallic (OM) vapor phase epitaxy (VPE) and hydride VPE. The system will use OM compounds such as triethyl gallium (TEG) and trimethyl indium (TMI) mixed with HC1 to produce volatile chlorides in a hydride-style hot wall reactor. These two features will allow the growth of very thin, abrupt interface layers (an OMVPE advantage) with a high growth rate (about 10um/hr) and low arsine consumption in a hot-wall system (a hydride advantage). In Phase I, we will (1) modify an existing vapor phase reactor by designing and installing a rapid gas switching manifold, (2) grow 3 um alternate layers of In.53Ga.47As/InP to demonstrate thin-layer growth capability, (3) grow and fabricate a 3 um thick In.53Ga.47As detector structure to demonstrate thin-layer growth capability, and (4) grow and fabricate a 3 um thick In.53Ga.47As detector structure to demonstrate overall quality of the materials. We will also submit a design for a compact, low-cost, but flexible merged system. In Phase II, we will build and optimize this growth system - including a safer arsine delivery - and fabricate thin-layer multi-quantum-well devices including 1.55 um DFB lasers and strained-layer infrared detectors.

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Topic#: 93-003 ID#: 93AVS-002
Office: AVSCOM
Contract #: DAAJ02-94-C-0004
PI: Dr. Ender Savrun

Title: Lightweight Flexible Armor for Aircraft Wiring Protection

Abstract: This program will develop a ballistic tape and a flexible fiber reinforced composite panel for use in lightweight, flexible modular armors against fragmentation protection. Required number of layers of ballistic materials based on woven and non-woven arramed and polyethylene fabrics will be consolidated in polymeric matrices, and formed into tapes and panels. The critical processing parameters affecting the flexibility of the tapes and panels will be investigated. Phase I work will involve examination of fiber type and denier, fabric style, polymer type and amount, and consolidation parameters to achieve desired level of flexibility and ballistic performance.

SIERRA MONOLITHICS, INC.
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REDONDO BEACH, CA 90277
Phone: (310) 379-2005
Topic#: 92-116 ID#: 92ETD-022
Office: ETDL
Contract #: DAAL01-93-C-3300
PI: Dr. Binneg Y Lao
Title: High Power Solid State Ku-band Transmitter
Abstract: A high power portable Ku-band transmitter using a DRO/FET/Doubler approach is proposed to replace a Magnetron for beacon transponder applications. The proposed technique can satisfy the system specifications in frequency stability, operating temperature, RF power, pulse modulation, pulse width and rise/fall time, pulse repetition rate, power consumption, and spur and harmonics levels. The proposed Phase I effort will provide a proof-of-concept system with an efficient frequency doubler to provide the required RF power at 17 GHz. The Phase I program will also include investigations regarding the use of high power FETs and MIMIC amplifiers directly at 17 GHz. A design using state-of-the-art higher power FETs satisfying the specifications in size, weight, and cost will be completed in Phase I and fabricated in Phase II. The proposed approach provides advantages in excellent temperature stability for output power and frequency, reliability, multiple device suppliers, simple power upgrading modular repairability, and the potential for CW operations.

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Phone: (602) 575-8013
Topic#: 92-109 ID#: 92ETD-060
Office: ETDL
Contract #: DAAL01-93-C-3303
PI: Dr. Angelo Yializis Ph.D
Title: Scale-up of RF Plasma Treated Capacitors for High Energy Density Applications
Abstract: Work by M. Binder and the Army ETDL has shown that the RF plasma treatment of capacitor films, electrode foils and wound rolls, can result in significant and in some cases dramatic improvements, in the electrical breakdown strength of certain capacitor films and capacitor rolls. In this investigation we will demonstrate potential commercial applications of the RF plasma treatment that will allow this technology to be licensed by film producers and capacitor manufacturers. In order to identify the commercialization potential of the film surface treatment, a high power hollow cathode RF reactor will be used to reduce the treatment time so that the process can be used to treat webs of film that are moving at production-like speeds. Contact angle, adhesion and ESCA analysis will be done on the surface of the films, to relate the data to the work done by the ETDL and further quantify effects of the O2 and CF4/02 plasmas. Treated films will be metallized with and with out exposure to air, and the self healing characteristics will be studied. Aluminum and tin foils with widths varying from 0.25" to 6.0" will be plasma treated and treated in wound capacitors, to determine the relationship of the foil edge treatment to the breakdown strength of the capacitors. Wound rolls will be plasma treated in a box etcher both by mechanical fixturing and by placing the rolls inside a cage that is rotating in the plasma chamber. The latter method will allow large quantities of small capacitors to be treated uniformly at a low enough cost, that will make this process cost effective even for marginal enhancements in the dielectric strength of the parts.

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Phone: (201) 539-2110
Topic#: 92-122 ID#: 92HDL-045
Office: HDL
Contract #: DAAL02-93-C-0009
PI: Gene Dwyer, Ph.D
Title: Low Cost, PC-Based Diffractive Optical Element Mask Generator and Frabricator
Abstract: Diffractive Optical Elements (DOEs) are finding applications in areas of artificial intelligence, optical computing, interferometry, holographic optical elements and mask and lens fabrication. However, research and development has been hampered by the lack of an affordable and practical method of printing computer generated DOEs. Silhouette Technology has developed a new technology to make a low cost, reliable, PC based, DOE film printer offering a high space-bandwidth product. The device offers performance which exceeds the capability of existing systems such as electron beam recorders and laser printers. It will be able to print with a resolution of 2 microns and a positioning accuracy of less than 1 micron. The system output will be directly to film and provide hard copy and photoresist printing. A complete system is proposed that offers software to print and generate computer generated DOEs.

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SIMPEX TECHNOLOGIES, INC.
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DIAMOND BAR, CA 91765
Phone: (714) 396-0720
Topic#: 92-123 ID#: 92HDL-055
Office: HDL
Contract #: DAAL02-93-C-0004
PI: Bernard K. Siu
Title: Panoramic Image Translation of Microelectronic Assemblies
Abstract: Many inspection criteria for microelectronics and surface mount device manufacturing processes require a 360 degree view of the component. Due to the limitation of traditional 2D sensor array technologies such as machine vision and laser dimensional measurement equipment, multiple views of the chip and its fillets must be taken for flaw detection and analysis. These methods require intensive image processing and is time consuming. High Speed Panoramic Inspection System (HSPIS) combines coherent image guide technology, structured illumination, panoramic image translation algorithm, machine vision and computer interface technologies into a system that "unfolds" a 360 degree view of an object into a 2D image array. This technique has two major benefits: (a) it improves current automated inspection speed by at least 400% and, (b) a portable or downloadable Panoramic Image Translation Function Library consisting of microelectronics flaw detection routines will be developed and available for other vision systems. With the support of Brunswick, this technique will be applied (Tech-Transfer) to surface inspection of composite launch tubes and miniaturized pressured vessels as well. The HSPIS will be integrated as an automated inspection system which can inspect all sides of a component in a 30 millisecond time frame. This system will have the intelligence to identify, locate and document the flaws with that time frame. Simpex will integrate and demonstrate, using actual samples, the performance of this inspection system to the Government representatives and guests.

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Phone: (714) 396-0720
Topic#: 92-124 ID#: 92HDL-057
Office: HDL
Contract #: DAAL02-93-C-0011
PI: Bernard K. Siu
Title: Solder-plating Process Control
Abstract: The objective of this effort is to develop and implement a scientifically based solderability tester (Sequential Electrochemical Reduction Analysis - SERA) as a process control tool during solder plating of electronic circuit boards. The study is to minimize "weak knee" solderability problems on the curved radius of plated through-holes. In addition, the design concept for an automated & ruggedized version of the present SERA tester will be developed. Simpex, with its factory automation expertise, will be integrating and implementing the SERA tester at Cedko Inc.'s printed circuit board manufacturing facility. Understanding the cause of oxidized metallization at "weak knee" locations, SERA test data will be collected at five strategic points in the printed circuit board plating line. Procedures specified in Mil-Std-105/E Level II AQL 1.5 will be used for data collection to ensure the largest sample size with minimum labor expenditure. Data collected at these locations will be analyzed to determine the type and amount of oxidation present. These statistical data or oxidation signatures, will in turn, be used to monitor and control the plating processes. In addition to the data collection and interpretation effort, software algorithms will be developed to interpret SERA readings or oxidation signatures in real-time, such that corrective actions can be recommended immediately by the system controller at each of the process control points. From the lessons learned in implementing the SERA tester, the design concept for an automated SERA test station with ruggedized features will be developed. This effort is anticipated to be completed in 6 months.

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Phone: (602) 893-6245
Topic#: 93-003 ID#: 93AVS-007
Office: AVSCOM
Contract #: DAAJ02-93-C-0025
PI: F. Stanton Lyons
Title: Development of Ballistic Protection Concepts for Critical Aircraft Wiring
Abstract: The development effort will be divided into two major tasks: develop and evaluate candidate protection concepts, and investigate and evaluate armor materials to be used in the concepts. There are unique ballistic protection concepts and armor materials which we will evaluate. We intend to consider, as a minimum, flexible and rigid armoring concepts. The flexible concepts are based on Simula's patented cable armor developed for the Army's M109 Self-Propelled Howitzer and M1A1 Abrams tank. The patented design consists of a series of common interlocking links that thread together to form a flexible cable armor. The rigid concepts involve the use of rigid half-cylinder sections that, when assembled together, completely encase and protect the wiring. We intend to consider conventional ballistic ceramics and composites as well as more advanced materials

such as cermets and metal matrix composites and less conventional transparent armors. This effort will be performed by the team of Simula, Inc., and Materials and Electrochemical Research (MER) Corporation. Simula's experience in cable armor development and ceramic composite armor development, combined with MER's experience in the manufacture of advanced cermets and metal matrix composites will ensure the best, lightweight, low-cost armor for critical aircraft wiring.

SIMULA, INC.
10016 S. 51ST STREET
PHOENIX, AZ 85044
Phone: (602) 893-6245

Topic#: 93-020 ID#: 93TAC-008
Office: TACOM
Contract #: DAAE07-93-C-R128
PI: Dr. Ken Lou

Title: Real-time Integrity/Durability Monitoring of Composite Structures Using a Fiber Optic Sensor System and Neural Network Processing

Abstract: The overall objective of this project is to develop a reliable, low-cost neural network architecture for sensors, and real-time processing to continuously monitor the structural health of the thick composite structure used in armored vehicles. The Phase I demonstration will be implemented with advanced fiber optic sensors for acquiring health and status data from a sample composite structure, a monitoring architecture for interconnecting the sensors, and use of advanced neural network techniques for learning the composite structure characteristics and discerned changes in the structural health of the composite. A team with expertise in composite materials, embedded fiber optic sensors, neural networks, and computer systems proposes to produce a proof-of-concept prototype using real hardware. The Phase I success is ensured through the leveraging of existing R&D by using fiber optic sensor prototypes developed at FIMOD, thick composite technology developed at Simula, and the neural network implementations of Sedona Scientific.

SONEX ENTERPRISES, INC.
12150 EAST MONUMENT DRIVE, SUITE 301
FAIRFAX, VA 22033
Phone: (703) 691-8122

Topic#: 92-038 ID#: 92C3 -033
Office: CECOM
Contract #: DAAB07-93-C-B254
PI: Dr. David C. Rine

Title: Tool Kit for Distributed Data Base Architecture

Abstract: The Information Distribution System concept provides the framework for establishment, distribution, and maintenance of object oriented databases within the future Army tactical command and control systems. This concept requires rules that completely describe the needs for combat information at each individual database maintained within the system, processes that locally compute updated values from the data in these databases, and triggers that permit data distribution based upon deviations from the computed norm. This effort will focus on the development of a toolkit of procedures to permit construction of the sets of rules, processes and triggers needed for generation and timely update of the Army tactical command and control systems databases. The SONEX approach centers on the utilization of object-oriented and intelligent reconfigurable software engineering technologies. Through these technologies distributed data systems can be developed more efficiently and will be more reliable and maintainable. To ensure the tool kits performance, test bed design will also be a critical part of this project. Test methodologies that will be investigated include statistical analysis and modeling techniques.

SOUTHWALL TECHNOLOGIES, INC.
1029 COPORATION WAY
PALO ALTO, CA 94303
Phone: (415) 962-9111

Topic#: 92-068 ID#: 92NAT-057
Office: NATICK
Contract #: DAAK60-93-C-0030
PI: Craig A. Grimes

Title: Development of Low Frequency, Flexible EMI Shielding Materials

Abstract: The electromagnetic interference (EMI) shielding effectiveness of a material of fixed thickness is a function of the incident wave frequency and the conductivity/permeability product of the shielding material. Effective low frequency shielding requires either a high conductivity/permeability product or a relatively thick piece of material. Current low frequency shielding materials compensate for limited conductivity/permeability values by increasing the thickness of the shielding material, which generally limits their application. This proposal is for the development of a low frequency, flexible EMI shield. To maintain flexibility the shielding material must be quite thin, typically below 20 um, therefore the conductivity/permeability product must be high. We propose to use an amorphous, non-magnetostrictive ferromagnetic alloy in a multilayer structure, with a metallic interlayer, to achieve high permeability and high conductivity. A moderate value coercive force is required to avoid saturation

of the shielding material. The design of the multilayer structure will be guided by analytic models developed for modelling shielding effectiveness. Other design issues include selection of substrate and shielding material combinations for superior adhesion, durability, and low cost as well as shielding effectiveness. Promising candidates will be fabricated to demonstrate the feasibility of such products.

SPACE EXPLORATION ASSOC.
141 WEST XENIA AVE. PO BOX 579
CEDARVILLE, OH 45314
Phone: (513) 766-2050

Topic#: 92-111 ID#: 92ETD-032
Office: ETDL
Contract #: DAAL01-93-C-0269
PI: Elliot B. Kennel

Title: Very Compact Cathode Ray Tubes Using Diamond P-N Junction Cold Cathode

Abstract: Very compact cathode ray tubes could be fabricated if high voltages presently required for normal operation could be reduced by a factor of ten. This requires a very effective cold cathode. A cold cathode capable of delivering several hundred amps per square centimeter (under ambient conditions without the introduction of cesium vapor) would be valuable for a number of applications in high power high frequency electronics. One of the most highly sought applications is that of cathode ray tube visual displays. Decreased voltage requirements would simplify the power supply requirements and allow a shorter CRT to be manufactured. This is of obvious utility to aerospace applications and could also be very attractive for consumer video displays as well. A method is described herein for manufacturing a cold cathode device using p-type diamond in direct contact with highly doped n-type silicon. Unlike other schemes for using diamonds as a cathode material, there is no need to manufacture n-type diamond.

SPECTRA RESEARCH, INC.
7071 CORPORATE WAY, SUITE 108
DAYTON, OH 45459
Phone: (513) 436-4454

Topic#: 93-036 ID#: 93SDC-007
Office: SDC
Contract #: DASG60-93-C-0113
PI: John W. Sellers, Jr.

Title: Performance Upgrade Kit for AN/MPS-36 Radars

Abstract: The AN/MPS-36 radar is a missile range instrumentation radar used for precision tracking of flight vehicles. Angular resolution is achieved by a monopulse lobbing technique. The AN/MPS-36 radars were built in the 1970's and since their inception have been subject to occasional tracking problems manifested as oscillation of the antenna in azimuth and/or elevation about the true track. In some instances simultaneous oscillation in both axes, or "spiraling" is unstable and can result in loss of track. Tests have shown that the AN/MPS-36 five-horn monopulse feed and comparator exhibit severe cross-coupling between the azimuth and elevation error channels in the presence of a cross-polarized component of the received signal. Tracking oscillation can be expected in the presence of this cross-coupling as the tracking servos attempt to correct this problem by replacing the present five-horn feed with a four-horn feed which is free of the cross-polarization errors of the present feed, and replacing or overhauling the parabolic dish.

SPECTRA RESEARCH, INC.
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Topic#: 92-065 ID#: 92NAT-003
Office: NATICK
Contract #: DAAK60-93-C-0028
PI: Paul D. Zidek

Title: Individual Combat Soldier Identification Technology

Abstract: For this Phase I SBIR, Spectra Research, Inc. proposes to research rugged, non-intrusive IFF concepts which employ unique low cost discrimination techniques to detect and positively identify friendly combat soldiers. The proposed design operates on passive non-cooperative emissive radiation and backscatter, augmented by cooperative multispectral retroreflective IFF devices. These devices digitally encode multispectral EO/IR and RF retroflection to assure high accuracy, robustness, and low intercept non-compromising operation. This combination provides secure sensor source data for operations over a broad set of adverse battlefield conditions. Neural net signal processing techniques fuse this data to enhance reliability over this diverse set of battlefield conditions.

SPECTRA RESEARCH, INC.
7071 CORPORATE WAY, SUITE 108
DAYTON, OH 45459
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Topic#: 92-097 ID#: 92STR-009
Office: STRICOM
Contract #: M67004-93-C-0037
PI: John W. Sellers

Title: A Next Generation Audio and Visual Cueing System for Tactical Engagement Simulation

Abstract: The firing of indirect fire weapons and the effect of incoming rounds have historically been simulated pyrotechnically. Weapon firing has been simulated by firing blank rounds and the effect of incoming rounds has been simulated by small explosive charges. Pyrotechnics have the advantage of being the simplest way to create the sound of an explosion, which is difficult to duplicate by other means. Moreover, the pyrotechnic mixture can be compounded to produce the desired levels of flash and smoke. Pyrotechnics also have several disadvantages. Being explosive devices, the charges present storage and handling hazards, and firing the charges carries the risk of igniting accidental fires. Spectra Research (S*R) proposes to overcome these limitations with a non-pyrotechnic explosion simulator that is compact, reusable, and configurable for a range of effects. The proposed simulator uses a pneumatic shock tube to generate the sound, a non-toxic aerosol agent to generate the smoke, and a flash tube to generate the flash of an explosion.

SPECTRAL SCIENCES, INC.
99 SOUTH BEDFORD STREET, #7
BURLINGTON, MA 01803
Phone: (617) 273-4770

Topic#: 92-159 ID#: 92MED-019
Office: MEDICAL
Contract #: DAMD17-93-C-3085
PI: Dr. Neil Boldstein

Title: Gallium Arsenide Semiconductor-laser Multigas Analyzer (GASMAN)

Abstract: The need exists for portable instrumentation with the capability of real-time monitoring of human environments for a variety of toxic gases generated by military weapons systems. Spectral Sciences, Inc. (SSI) proposes to build a Gallium Arsenide Semiconductor-laser Multigas Analyzer (GASMAN) which will provide automatic, unattended, real-time monitoring of several toxic gases. GASMAN employs multiple diode-laser in conjunction with multiplexing techniques to simultaneously monitor air samples for five or more toxic species in a common flow-through sampling cell. GASMAN uses techniques of wavelength modulation and line-locked absorption detection common to several gallium arsenide-based sensors developed by SSI for automated and unattended operation in the detection of single species in open air. GASMAN incorporates these features, along with a long-path absorption cell, multiple diode-laser sources, and multiplexing techniques. An internal microprocessor system controls experimental sequencing and stores several hours of continuous concentration data with sub-second time resolution. The resulting system is portable, compact, lightweight, and has low power consumption requirements. The objective of this work is to develop a prototype system for deployment in military applications. Phase I will demonstrate the feasibility of the GASMAN approach by monitoring representative toxic gases using a breadboard incorporating three basic elements; line-locked detection, a multiple-pass absorption cell, and multiplexed laser-diodes. Phase II development will lead to a working prototype.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000

Topic#: 92-044 ID#: 92NV -046
Office: CECOM
Contract #: DAAB07-93-C-U009
PI: Anton C. Greenwald, Ph.D.

Title: Epitaxial MOCVD of Thin Film Ceramics for Pyroelectric Detectors

Abstract: Spire proposes to deposit very thin films of lead-titanate by Metal Organic Chemical Vapor Deposition (MOCVD) for use as pyroelectric detectors. A multilayer structure will be fabricated to create an epitaxial, thermally isolated detector element with higher sensitivity than that of the thick films presently being used. MOCVD is an innovative technique which allows sequential heteroepitaxial growth of electrical and thermal insulators, electrically conducting layers, and pyroelectric materials. In Phase I, Spire will use its unique capabilities to deposit (metal)/PbTiO3/CoSi2 on silicon and will measure lead titanate's pyroelectric coefficient. Prototype infrared sensors with integrated FET's would be fabricated in Phase II. Integrated pyroelectric detector arrays made possible by this technology would have greater sensitivity and resolution arrays produced by existing hybrid fabrication processes.

STANNOUS TECHNOLOGIES CORP.
65 NEW SALEM ST
WAKEFIELD, MA 01880
Phone: (617) 246-1119

Topic#: 92-124 ID#: 92HDL-061
Office: HDL
Contract #: DAAL02-93-C-0033
PI: Pranjivan V. Popat, Ph.D

Title: Extend SERA to Improve Solderability of Components by Controlling the Formation, Growth & Oxidation of Cu-Sn Intermetallics

Abstract: The proposal describes an innovative R & D program to improve solderability of electronic components by controlling the formation, growth and oxidation of Cu-Sn intermetallic compounds (IMC). The rate and extent of IMC growth depends, among other factors, on the microstructure of the finish plate on the Cu substrate. Differences in microstructure such as porosity, grain boundaries, fissures, delamination and other defects, provide variable paths for solidstate diffusion of Sn and oxidants to Cu substrate. These results in different rates of solderability degradation on aging. Three different types of plating and thickness will be used to produce different types of microstructures. These will include: (1) Electroplate at 3 levels of current densities to get 1, 3 and 6 um thickness; (2) Hot tin dip coating using 3 different coating cycles to produce 1, 3 and 6 um finish; and (3) Solder reflow of electroplated samples. Finish thickness and composition will be measured by XRF and microsection. Solderability at various stages of aging will be measured quantitatively by SERA. "Dip and Look" and wetting balance methods will be used as required. Accelerated aging will be accomplished by: (1) Steam aging below 95 degrees C; (2) Controlled heating in inert atmosphere; and (3) Anodic oxidation of samples in SERA apparatus. Microstructure will be determined using optical microscopy as well as modern surface science techniques (SEM, TEM, AUGER/ESCA) as needed. This part will be performed at the Center for Materials Characterization, University of North Texas, Denton, Texas.

STARFIRE SYSTEMS, INC.
P. O. BOX 2628
GLENVILLE, NY 12302
Phone: (518) 276-2673

Topic#: 92-134 ID#: 92MTL-131
Office: MTL
Contract #: DAAL01-93-C-4012
PI: Dr. Chris Whitmarsh

Title: Engineered, Ceramic Reinforced, Ceramic Matrix Composites

Abstract: A processing route to fiber-reinforced, SiC matrix composites which involves resin transfer molding with a hydridopolycarbosilane preceramic polymer is proposed. This proprietary liquid resin thermosets to a rubbery solid at 200-400 C, permitting fabrication of free-standing, molded parts. Pyrolysis at 1000 C gives near-stoichiometric SiC with 80-90% ceramic yield. Multiple infiltration, cure, and pyrolysis cycles would be used to prepare composites with less than 10% porosity. Test specimens for bend, fracture toughness, and interlaminar shear testing would be produced. The microstructure, mechanical properties, and thermal stability of the composites would be evaluated.

STEROIDS, LTD.
CHICAGO TECHNOLOGY PARK, 2201 WEST CAMPBELL PARK
CHICAGO, IL 60612
Phone: (312) 421-7158

Topic#: 92-162 ID#: 92MED-043
Office: MEDICAL
Contract #: DAMD17-93-C-3081
PI: Kaiming Liu

Title: Monoclonal Catalytic Antibodies Directed Towards Organophosphorus Agents

Abstract: The hapten molecule CF3(CH3)P(OR)3 which mimics the transition state for hydrolysis of organophosphates such as soman will be synthesized. A protein conjugate will be used for monoclonal catalytic antibody production. A key element of the hapten is that it is a phosphorate (pentacoordinate phosphorus) and contains the CF3PCH3 group. The synthesis depends upon new chemistry which we have discovered for phosphorates and trifluoromethyl phosphorus compounds. The highly electronegative CF3 mimics an anionic oxygen bond to phosphorus and also stabilizes the phosphorate hapten towards hydrolytic decomposition. This novel hapten represents a closely proximate model for the transition state in organophosphate hydrolytic cleavage and should enable production of a highly effective catalytic antibody for organophosphate neutralization. The project is a collaborative effort between Steroids, Ltd which will do the synthesis, conjugation and hapten-protein ratio determination, and USAMRICD which will generate monoclonal catalytic antibodies and determine their activity towards hydrolytic cleavage of soman.

STEWART COMPUTATIONAL CHEMISTRY
15210 PADDINGTON CIRCLE
COLORADO SPRINGS, CO 80921
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Topic#: 93-013 ID#: 93CRD-014
Office: CRDEC
Contract #: DAAA15-93-C-0067
PI: James J. P. Stewart

Title: Development of AM1 Semi-empirical Parameters for the Group III, V, and VI Elements

Abstract: Reference data abstracted from literature sources, such as NIST and JANAF, as well as original research publications, will be used in the construction of data-sets. These data-sets will be suitable for use in parameterizing elements at the AM1 level, and, with appropriate modification, for parameterizing elements for other semi-empirical methods. As several elements in Groups III, V, and VI have already been successfully parameterized at the AM1 level, and as the amount of reference data for some elements is known to be very small, the focus of this work will be on the elements Gallium, Arsenic, Selenium, Antimony and Tellurium. An attempt will be made to develop a working set of parameters in order to determine the feasibility of more complete parameterizations. The results of earlier parameterization projects indicated that a two-way dialog between the research group carrying out the parameterization and field users of the parameter sets is essential.

STOTTLER HENKE ASSOC., INC.
916 HOLLY ROAD
BELMONT, CA 94002
Phone: (415) 595-1692

Topic#: 93-022 ID#: 93STR-012
Office: STRICOM
Contract #: M67004-93-C-0084
PI: Richard H. Stottler

Title: Case-based Reasoning for Simulation Based Intelligent Tutoring

Abstract: In Phase I we will demonstrate the benefits of using a Case-Based Reasoning (CBR) paradigm to build a simulation-based Intelligent Tutoring System (ITS). SHAI is uniquely qualified based on our previous simulation and ITS experience. Because students often learn best by example, we intend to design a tutoring system around example problems. These examples are presented as simulations. We will apply the Artificial Intelligence (AI) technique of CBR to capture and represent the example problems (or cases) and provide explanations to student teams on problem solving techniques. The system would be sensitive to the students' knowledge of problem solving principles and student tailor the teaching sessions accordingly. The body of knowledge contained in the system could be expanded over time simply through addition of more problems. An ITS is an exciting supplement to traditional classroom instruction. It offers the possibility of individualized teaching and allows the student to work at his own pace, mitigating the problems of staff cutbacks and increasingly complex subject areas. In Phase I, we will design a generic simulation-based ITS using a CBR paradigm. The feasibility of the system will be proven through implementation of a proof-of-concept prototype in a specific domain.

SURFACE SOLUTIONS, INC.
1727 CONESTOGA ST.
BOULDER, CO 80303
Phone: (303) 442-0156

Topic#: 92-003 ID#: 92ARD-030
Office: ARDEC
Contract #: DAAA21-93-C-0069
PI: John Marshall III

Title: Advanced Materials/Coatings for Gun Barrels

Abstract: The application of advanced barrel coatings to provide extended erosion and wear life with high performance ammunition for existing and proposed weapons systems has been limited by the available process technologies capable of applying the required/desired coatings. Electroplating, Chemical Vapor Deposition (CVD), and Physical Vapor Deposition (PVD) have all been attempted with varying degrees of success. Desired coating materials are best applied using PVD, however PVD has suffered from geometric constraints due to a line-of-sight requirement from target to substrate. Surface Solutions (SSI) has developed a new form of PVD deposition, DC Linear Magnetron Sputtering (LMS), capable of uniform deposition inside a gun barrel with a length to diameter ratio exceeding 100:1. SSI believes that LMS will be capable of uniformly depositing high-temperature, corrosion resistant materials such as tantalum, alloys of tantalum, molybdenum, niobium, etc. LMS is a line-of-sight PVD process whereby the target(coating material) is tubular and is aligned coaxially with the substrate (gun barrel). Sputtering occurs radially and uniformly down the entire length of the target and requires no external magnets to contain the plasma. The required uniform magnetic field is generated electrically and is the basis of SSI's LMS process.

SYMBIOTECH, INC.
8 FAIRFIELD BLVD.
WALLINGFORD, CT 06492
Phone: (203) 284-7465
Topic#: 92-166 ID#: 92MED-012
Office: MEDICAL
Contract #: DAMD17-93-C-3082
PI: Edward M. Davis, Ph.D.
Title: Toxin Prophylaxis
Abstract: A novel approach for developing prophylactic agents against ricin is proposed. During Phase I, a prototype of the proposed prophylactic will be synthesized and tested for its ability to detoxify ricin. The work aims to demonstrate feasibility of the proposed approach. It is anticipated that the proposed approach may be used to develop broad spectrum protection against toxin and biological warfare agents.

SYSTEM ENGINEERING TECHNOLOGY SERV.
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CAMPBELL, CA 95008
Phone: (408) 241-0860
Topic#: 92-034 ID#: 92SS -001
Office: CECOM
Contract #: DAAB07-93-C-A508
PI: David M. Theobold
Title: Autonomous Satellite Location Using a Hand-held Theodolite
Abstract: A hand-held theodolite shall be developed which has the capability to autonomously locate satellites, given multiple satellite ephermerides, date, time, and ground terminal location. The theodolite shall provide a local reference of azimuth and elevation angles via electronic sensors, calculate antenna pointing angles for the time during which the satellite is in view, and display the times for which a satellite will be visible. The first phase of this development shall provide detailed system requirements, functional specifications, and a preliminary design approach for the theodolite hardware and software. Brassboard evaluation of the key sensor technologies and processing algorithms shall also be performed in this phase.

SYSTEMS & PROCESSES ENGINEERING CORP.
1406 SMITH ROAD
AUSTIN, TX 78721
Phone: (512) 385-2067
Topic#: 92-047 ID#: 92CRD-005
Office: CRDEC
Contract #: DAAA15-93-C-0034
PI: Dr. Robert C. Chin
Title: Early Warning and Monitoring of Dangerous Biological Materials by Phase-resolved Fluorescence Spectroscopy
Abstract: Systems & Processes Engineering Corp. (SPEC) has developed a Phase Resolved Fluorescence Spectroscopy (PRFS) biosensor which is capable of detecting and classifying biological materials. SPEC's PRFS biosensor uses lifetime fluorescence to provide: (1) enhanced sensitivity to structural differences associated with various classes and species of bacteria, and (2) a means to reduce fluorescence interference from other bacterial fluorophores. SPEC has shown that lifetime determination by phase and frequency can achieve picosecond resolution. This resolution is sufficient for discriminating between bacterial species and classes. PRFS is based on the physical phenomena occurring when a fluorescent bacteria is excited with sinusoidally modulated light, inducing a phase shifted emission corresponding to the time lag between absorption and fluorescence. These "phase" fluorescence parameters are used to generate Excitation Emission Frequency Arrays (EEFAs) for use in detecting, classifying and monitoring concentration changes of potentially dangerous bacterial/biological materials. In Phase I, SPEC will: (1) develop a PRFS Biosensor System specification; (2) design a signal processing scheme; (3) perform PRFS biosensor laboratory investigations and demonstrations; (4) design a miniaturized PRFS Biosensor, incorporating a Multi-Chip Module (MCM) technology and leading to a Phase II PRFS Biosensor prototype, which will be delivered to the Army for field evaluation.

SYSTEMS ENGINEERING ASSOC. (SEA CORP)
ADMIRAL'S GATE TOWER, 5TH FLOOR, 221 THIRD STREET
NEWPORT, RI 02840
Phone: (401) 847-2260
Topic#: 92-149 ID#: 92TOP-057
Office: TOP
Contract #: DACA76-93-C-0005
PI: Michael G. Fisk
Title: Develop Environmental Monitoring Capability for Intergrating Recent Technological Advancements into a Hybrid Artificial Neural Network System
Abstract: We propose to develop an Environmental Monitoring System by integrating various technologies to create a hybrid artificial neural network system. By functionally decomposing the requirements of environmental monitoring we can apply emerging technologies to fulfill these modularized requirements. Ten (10) years of experience indicate that the technologies

directly applicable to specific requirements are: Artificial Neural Networks, Fuzzy Logic, Artificial Intelligence, and Object-oriented Database Management Systems. We feel that to successfully develop a system using such diverse technologies, the major technical problem is the integration of these modules. By functionally decomposing the requirement the hybrid system can be built in a modular, object-oriented manner. This ensures that the best, effective technology has been applied to the respective requirement. Any new technological advances can then be easily integrated into the hybrid system. Scientists presently involved in environmental research, ANN, AI, Fuzzy Logic, data comparison, and advanced system engineering will be used. These personnel will apply existing designs which successfully resolved similar problems in their respective technologies, minimizing risk of completion while leveraging available funds. GEOPHYSICS, a commercial environmental firm, has expressed a strong desire to use and commercialize the environmental monitoring System to support their own business and profession.

SYSTEMS ENGINEERING GROUP, INC.
9841 BROKEN LAND PARKWAY #214
COLUMBIA, MD 21046
Phone: (410) 381-8740

Topic#: 92-176 ID#: 92SDC-079
Office: SDC
Contract #: DASG60-93-C-0013
PI: Robert Bulk

Title: Real-time Drag Determination for Kwajalein Missile Range (KMR) Tracking Development

Abstract: The primary goal of the Phase I effort is to develop an algorithm and determine its feasibility, for Kwajalein Radars, to estimate and correct for drag acceleration on reentry objects. In developing the design an evaluation of both KMR radar tracking performance and reentry object trajectories will be performed to determine the performance requirements of the drag estimation and correction algorithm. Using these requirements an algorithm will be designed that recursively estimates the aerodynamic characteristics for an object and then uses this information to predict the location of the object at the next update. This design will be analyzed to determine its performance on specific KMR Radars (ALCOR, MMW, FPQ-19). The result of Phase I will indicate the effectiveness of the algorithm and its applicability to KMR (and other test range) tracking needs. Phase II will validate the algorithm using simulation and real KMR data and then deliver the algorithm. Phase II will also include an assessment of the commercial applications for the tracking filter.

SYSTEMS TECHNOLOGY, INC.
13766 SOUTH HAWTHORNE BLVD.
HAWTHORNE, CA 90250
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Topic#: 93-004 ID#: 93AVS-017
Office: AVSCOM
Contract #: NAS2-13885
PI: Warren F. Clement

Title: Modeling Complex Automatic Flight Controls for Helicopter Systems

Abstract: The U.S. Army is currently developing a Second Generation Comprehensive Helicopter Analysis System (2GCHAS) to provide significant improvements in helicopter analysis capability, but it is currently restricted to simplified flight control system models. The technical objective of the Phase I work is to develop a specification and conceptual design for advanced control system modeling capabilities in the 2GCHAS that will be compatible with current 2GCHAS architecture and allow the user to adopt familiar control system block diagrams to generate flight control system models. Proposed herein is a two-stage process providing advanced flight control system (FCS) modeling capabilities in the 2GCHAS. In the first stage, the analyst would also utilize the high level control system graphical design interface, TUTCAD, for the TUTSIM block diagram simulation program. This procedure would generate a TUTSIM FCS model file that could be checked out in an open-loop fashion utilizing the control system modeling program TUTSIM prior to the second stage of the FCS design process: full-scale analysis and simulation using 2GCHAS. The second stage of the FCS design process will be addressed in Phase I by developing a specification of the necessary modifications to the Technology Input Processor (TIP) Computer Program Configuration Item (CPCI), developing a specification for necessary modifications to the Technology Complex, developing a specification and conceptual design for the version of TUT MACHINE tailored to the 2GCHAS architecture to support the FCS module, developing maneuver command modules for the FCS CPCI, and combining the above specifications into a comprehensive specification and conceptual design for the advanced FCS CPCI for 2GCHAS.

SYSTEMS TECHNOLOGY, INC.
13766 S. HAWTHORNE BLVD.
HAWTHORNE, CA 90250

Topic#: 92-013 ID#: 92AVS-071
Office: AVSCOM
Contract #: DAAJ02-93-C-0010

72

Phone: (310) 679-2281 PI: David G. Mitchell
Title: Reconfigurable Flight Controls
Abstract: For the military helicopter in combat, the loss of a control surface under any circumstance usually translates into either an emergency landing or complete loss of control. A critical factor in determining the pilot's chance of maintaining control is the level of redundancy in control effectors, or more correctly, the lack of such redundancy. Unlike fixed-wing aircraft, the control effectors on the conventional helicopter are integrated, so that, in the event of a failure, the pilot's task of determining the proper control strategies and continuing to a safe landing is extremely difficult. There is a potential for assisting the pilot on future designs by implementing reconfigurable flight control system (RFCS) algorithms. Such approaches are showing promise for fixed-wing aircraft; their application to helicopters, however, requires a recognition of the distinct differences between fixed- and rotary-wing aircraft controls and responses. This proposal presents an approach to the subject starting with demonstrating the feasibility of producing a controllable impaired aircraft. If funded, the Phase I work will examine all possible failures for a current helicopter, focusing on one example critical failure. For this failure the feasible flight control laws to provide Level 3 (or better) flying qualities will be developed.

SYUKHTUN RESEARCH Topic#: 92-155 ID#: 92ARI-025
2740 WILLIAMS WAY Office: ARI
SANTA BARBARA, CA 93105 Contract #: MDA903-93-C-0144
Phone: (805) 682-2835 PI: Jim Kornell
Title: Training-based Requirements for Semi-automated Forces
Abstract: "The training of soldiers, leaders and units to win in combat will remain the Army's single most important task"-US Army Fiscal Year 1993 Posture Statement (quoted in Military Review, May 1992). The Department of Defense spends an estimated $5 billion per year on training. Simulations can aid training, but there is no reliable method for generating simulation requirement from training objectives, nor are there productive automated aids. Yet people perform the task, some with high degrees of expertise. We propose research to develop a well defined method for performing the task. We also propose to construct a knowledge based system to support portions of the task. In combination, this can be expected to improve efficiency and effectiveness in the training-objective-to-performance-requirement task.

TE TECHNOLOGY, INC. Topic#: 92-077 ID#: 92TAC-012
10345 CHERRY BEND ROAD Office: TACOM
TRAVERSE CITY, MI 49684 Contract #: DAAE07-93-C-R015
Phone: (616) 929-3966 PI: Richard J. Buist
Title: Thermoelectric Thick Film Technology for Application onto Substrates .
Abstract: New advances in Ultra-Supersonic Plasma-Spray technologies present new opportunities for creating a superior thermoelectric (TE) thick-film technology. Via extremely rapid solidification, these processes can maintain the purity and complex stoichiometry of multi-component TE alloy. This process will eliminate the use of solders yielding unprecedented ruggedness and low cost. Unlike sputtering and other deposition processes which require high vacuum, ultra-clean systems and hours to build up a few microinches, the proposed process can be operated in open air and deposit several thousand microinches in a single pass. These thick-film layers will have the capacity to provide practical cooling in the presence of significant heat loads. TE Technology, Inc. will draw on its experience and success on previous SBIR programs using the wide range of TE material compositions developed under its Navy SBIR program. Forty different N and P-type films will be designed, fabricated and tested to establish the feasibility of the plasma-spray, thick-film technology. Testing will include full characterization of all TE transport parameters. Actual cooling performance tests will also be made including the use of temperature sensitive, liquid crystal films to visually observe temperature gradients under operation.

TECHNICAL EVALUATION RESEARCH, INC. Topic#: 93-033 ID#: 93MED-079
LITTLE SILVER COMMONS, 200 WHITE RD, SUITE 207/2 Office: MEDICAL
LITTLE SILVER, NJ 07739 Contract #: DAMD17-93-C-3150
Phone: (908) 219-0020 PI: BENJAMIN TIRABASSI
Title: A Transducer/Equipment System for Capturing Speech Information for Subsequent Processing by Computer Systems
Abstract: The objective is the exploratory research to parameterize the speech signal and provide measurements which maximize

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the speech intelligibility and talker-identification while minimizing the effects of noise and interference. Performance of speech transducers and noise canceling systems have been bench-marked significantly for applications under controlled conditions. This basic research will investigate new signal processing and speech parameterization techniques for more robust performance in noise conditions. Additionally, the effects of channel media interference will be quantified and superimposed for several expected applications to evaluate the enhanced performance derived from these new concepts. The new algorithms and noise/interference abatement techniques will demonstrate immunity to a broad range of acoustic noise and transmission media conditions. The technical approach consists of two parallel activities which individually focus on: 1) the identification of novel ways to isolate the signal from the noise to improve speech intelligibility and speaker identification scores, and 2) development of performance bench-marks to demonstrate the improvements in speech recognition under noisy acoustic conditions and over channels that filter or otherwise interfere with speech signal quality features.

TECHNICAL SOLUTIONS, INC.
P.O. BOX 1148
MESILLA PARK, NM 88047
Phone: (505) 524-2154
Topic#: 92-088 ID#: 92TAC-138
Office: TACOM
Contract #: DAAE07-93-C-R029
PI: Dr. Alton L. Gilbert
Title: Generation of Terrain Databases for VCDD
Abstract: The Defense Mapping Agency (DMA) is the primary provider of terrain data to the military services. Other agencies, such as the US Army Engineering Topographical Laboratory, provide terrain data products as well. DMA currently provides Digital Terrain Elevation Data (DTED) and Interim Terrain Data (ITD) as the high resolution terrain data products usable by maneuver forces. Also emerging, but in very limited data sets, is the follow on to ITD called the Tactical Terrain Database (TTD). The generation of terrain data for plan-view and perspective-view display from the DMA data will vary in complexity depending upon the display requirements, including resolution; the source and resolution of the data; and the icons/symbols added to the display to meet a military planning, control, or training objective. US Army TACOM, in developing Soldier-Machine Interfaces (SMI), has developed the Vetronics Crew Display Demonstrator (VCDD) to display data to the surrogate crew member and evaluate data presentation requirements, data presentation efficiency (human factors), and control mechanisms. The VCDD requires new and additional terrain data for meaningful evaluation of SMI, which is the purpose of this proposal.

TECHNICAL SOLUTIONS, INC.
P.O. BOX 1148
MESILLA PARK, NM 88047
Phone: (505) 524-2154
Topic#: 92-089 ID#: 92TAC-145
Office: TACOM
Contract #: DAAE07-93-C-R031
PI: Dr. Alton L. Gilbert
Title: Embedded Training for ITCS
Abstract: The US Army is continually faced with the task of providing the crew members of weapon systems with realistic, high-quality training. This training must be based on known principles of instructional design, yet meet the needs of specific weapon system based training issues. The problem of providing quality training compounded by a reduction in force, results in smaller crews. There will also be few trainers, training developers, and smaller support staff for production of training materials. In addition, training production costs are rising. The crew size reductions in Army weapons systems have been made possible by Intelligent functions such as Decision Support Systems/Decision Aids which perform operations normally associated with crew members. These cooperative, computer-based systems will require a different level of training than was previously provided. Decision Support Systems are now being developed for armor and artillery, and these systems will require Embedded Training for all crew members. U.S. Army TACOM has developed a Vetronics Crew Display Demonstrator (VCDD) for development and evaluation of concepts relating to future vehicle-based weapons systems requirements. A major focus of this effort are the requirements for the Integrated Two-man Crew Station (ITCS). The ITCS architecture will integrate the physical, electronic, intelligent subsystems, training and control functions into a fieldable configuration. The effort proposed here is directed at the Embedded Training component.

TECHNO-SCIENCES, INC.
7833 WALKER DRIVE, SUITE 620
GREENBELT, MD 20770
Topic#: 92-082 ID#: 92TAC-054
Office: TACOM
Contract #: DAAE07-93-C-R022

Phone: (301) 345-0375 PI: William Bennett
Title: ProtoFlex Multibody Dynamical Analysis System
Abstract: The objective of the proposed work is the development of a CAD system for the design and analysis of multibody dynamical systems with flexible substructures. We shall start with multibody modeling formalisms developed and used by TSI for large scale flexible structures and combine these with the PROTOFLEX system developed by the Grumman Corp. The project will involve a collaboration between TSI and Grumman to achieve the final product.

TECHNOLOGY INTERNATIONAL, INC. Topic#: 92-066 ID#: 92NAT-026
429W. AIRLINE HIGHWAY, SUITE S Office: NATICK
LAPLACE, LA 70068 Contract #: DAAK60-93-C-0023
Phone: (504) 652-1127 PI: Mr. Sherman Richardson
Title: Ultrasonic Dehydration for Dental Liquid Meals
Abstract: Technology International Incorporated (TII) will develop, design, fabricate, and test an ultrasonic dehydration process that can be used to dry ingredients in as little as 10 seconds, to produce ingredients with excellent quality for dental liquid meals, high calorie compact food modules, and other ration applications using a relatively inexpensive dehydration process. The energy cost will be far less than the freeze drying method currently being used to produce the same items. The ability to rehydrate and to retain the nutrients would be greatly improved due to the extremely short residence time at high temperatures. The Phase I work will involve identifying the ingredients most suitable for ultrasonic drying and establishing the range of process parameters applicable to them. Also, a bench test will be performed to validate the range and assure compatibility of the ingredients with ultrasonic drying.

TEXAS RESEARCH INSTITUTE AUSTIN, INC. Topic#: 93-007 ID#: 93BRD-011
9063 BEE CAVE ROAD Office: BRDEC
AUSTIN, TX 78733 Contract #: DAAK70-94-C-0003
Phone: (512) 263-2101 PI: Alan V Bray
Title: Accelerated Reliability Testing for Environmental Control Systems
Abstract: Reliability and lifetime performance data for environmental control systems (ECS) is limited. Real-time tests require 5-15 years, and results often apply only to obsolete technology. Accelerated life testing (ALT) is a means by which reliability data may be obtained quickly and at a reasonable cost. A primary difficulty with ALT of ECS units is that typical service conditions impose multiple stresses on the hardware. Each stress must be accurately modeled in order to correlate normal aging with accelerated again at balanced so that the aging rates are equal for all induced stresses. ECS operating profiles will be characterized for different geographic areas, and these data will be used to design a complete, multiple stress, multiple acceleration factor ALT. Included in the ALT design will be test apparatus diagrams, methods for accelerating normal aging rates using elevated stress levels, monitoring methods for the collection of relevant data, and statistical analysis techniques for producing reliability estimates from the ALT data. Initial aging investigations will be made using ON/OFF duty cycle acceleration for small air-conditioning units.

TORREY SCIENCE & TECHNOLOGY CORP. Topic#: 92-030 ID#: 92SS -020
9725 SCRANTON ROAD, SUITE 100 Office: CECOM
SAN DIEGO, CA 92121 Contract #: DAAB07-93-C-A506
Phone: (619) 552-1052 PI: Thomas S. Seay
Title: Tracking & Reporting System (TRS)
Abstract: A surveillance tracking and reporting system (TRS) capable of self position determination combined with a means of communicating its position through satellite data links to a tactical monitoring and control center would provide valuable assistance to counter narcotics and other special operation forces. A TRS system is proposed which would utilize small (shirt-pocket size or less), light weight, low power consumption terminals with omni-directional antennas. The system should provide position location to better than 25 meters anywhere over land or ocean. Terminals would be capable of 2-way data communications, would be inexpensive (many may be lost or non-recoverable) and would have a battery life goal of 36 to 48 hours minimum. Such a system would also include a second version of the terminal for use by law enforcement officers. This terminal would contain a small readout LCD display and a keyboard for sending short messages in the field or to the tactical

control and monitoring center. The officer's terminal would have an emergency button to immediately transmit an officer-in-trouble message with a location.

TOYON RESEARCH CORP.
SUITE A, 75 AERO CAMINO
GOLETA, CA 93117
Phone: (805) 968-6787
Topic#: 92-176 ID#: 92SDC-078
Office: SDC
Contract #: DASG60-93-C-0015
PI: A. Vincent Mrstik

Title: Real-time Drag Determination for Kwajalein Missile Range (KMR) Tracking Development

Abstract: Although the wideband, narrow beam radars at KMR are capable of tracking well-behaved targets during reentry, the radars do not reliably maintain track on targets whose drag profiles deviate significantly from a priori predictions. The objective of this effort is to determine the feasibility of augmenting existing tracking filters for the KMR radars to allow real-time computation, correction, and prediction of reentry drag experienced by objects in track. The existing KMR track filters attempt to compensate for drag excursions by increasing the process noise when predictions are observed to deviate from the measurements. Rather than simply increase the process noise, our proposed approach is to use the observed deviations between the predicted and observed measurements to modify/improve on our a priori estimate of vehicle drag profile. Our approach can be described as one of using drag as an additional state variable which is estimated in real time using the predictor/corrector processes of Kalman filtering. A digital simulation will be used to refine our new algorithm and to compare its performance with the existing KMR track filters for a wide spectrum of drag profiles. Feasibility of the revised tracker will be evaluated in terms of its ease of implementation in the existing real-time programs of the KMR radars, and the ability of the existing computing hardware to absorb the additional computational load.

TPL, INC.
3754 HAWKINS NE
ALBUQUERQUE, NM 87109
Phone: (505) 345-5668
Topic#: 92-002 ID#: 92ARD-041
Office: ARDEC
Contract #: DAAA21-93-C-0017
PI: Dr. Robert D. Chapman

Title: TNAZ Formulations with Enhanced Energetic Output

Abstract: 1,3,3-Trinitroazetidine (TNAZ) exhibits some unusual and potentially valuable properties for explosives applications. Objectives of Phase I program include the selection of candidate energetic formulations using computational methods. A technical prerequisite to performing valid computations of energetic performance of composition is a basic understanding of their physical properties. In the case of binary formulation, this must include the parameters of solid-state solutions. Performance calculations of formulations of Greates theoretical interest (following characterization of phase equilibria) will be conducted. ARDEC's TIGER PC will be of greates utility in this project for determining thermochemical and hydrodynamic properties of formulations. The most theoretically promising candidates will be formulated in small batches, and formal thermal stability and sensitivity testing will be conducted.

TPL, INC.
3754 HAWKINS NE
ALBUQUERQUE, NM 87109
Phone: (505) 345-5668
Topic#: 92-004 ID#: 92ARD-042
Office: ARDEC
Contract #: DAAA21-93-C-0015
PI: H.M. Stoller

Title: Development of Non-lethal Weapon Mechanisms

Abstract: There is growing interest in non-lethal weapons. Minimization of U.S. forces and non-combatant casualties are primary personnel considerations. Other targets of interest include sensors, electronic systems, thermal sights, missile seekers, missile guidance, and TV's. Previous non-lethal weapon development has emphasized personnel targets, riots, and hostage situations. Civilian applications included kinetic energy weapons and electrical shock devices. Military developments have included riot control (chemical) agents and kinetic energy weapons. These weapon concepts have limitations and/or restrictions applied to combat situations. New concepts are needed for personnel targets. This innovation need is emphasized for consideration of electronic, electro-optic, and electronic targets. Acoustic, optical and electromagnetic effects have the greatest potential for multi-target uses in broad area applications. Enhancement techniques have been identified particularly for optical and EMP effects. Application scenarios will be defined. Non-lethal weapons concepts will be identified and quantified. Incapacitation requirements will be established. Interaction effectiveness of selected non-lethal mechanisms with selected targets

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will be predicted. Based on a relative merit index, recommendations will be made for Phase II development.

TPL, INC.
3754 HAWKINS NE
ALBUQUERQUE, NM 87109
Phone: (505) 345-5668
Topic#: 92-109 ID#: 92ETD-045
Office: ETDL
Contract #: DAAL01-93-C-3302
PI: Dr. Richard W. Brotzman,
Title: High Energy Density Polymer Capacitor Development
Abstract: The development of low loss, high energy/high power density storage materials is important for Army applications ranging from capacitors to pulse power component technologies. To maximize the energy density of a high energy density polymer capacitor, not only must the constituent polymer material properties be optimized, but the best capacitor fabrication/production techniques must be employed. Adhesion of vapor deposited aluminum as well as the breakdown voltages of a number of polymer films have been markedly increased after these polymer films have been briefly exposed to various low pressure, low temperature gas plasmas. Initial evaluations on prototypes, spirally wound polymer capacitors (capacitor was briefly exposed to a 96% CF4/4% 02 gas plasma) have shown that breakdown voltage can be increased by a factor of 2-4. Why does plasma processing significantly improve breakdown strength, and what are the optimum plasma processing conditions that produce these improvements without causing any undesirable effects on other bulk properties of the capacitor polymer? TPL will develop and demonstrate various spirally wound, capacitors based on specific ETDL inventions/patents which have already been prototyped and successfully demonstrated. Selected polymer films and capacitors will be fabricated and subjected to plasma treatments to identify both the optimum processing conditions and the fundamental basis for the dielectric breakdown improvements. TPL will identify specific military and commercial candidate applications and users for the optimized technology.

TPL, INC.
3754 HAWKINS NE
ALBUQUERQUE, NM 87109
Phone: (505) 345-5668
Topic#: 92-140 ID#: 92CER-029
Office: CERL
Contract #: DACA88-93-C-0007
PI: H.M. Stoller
Title: Reuse of Nitrocellulose-based Propellants in Industrial Processes
Abstract: The DoD is faced with a large and growing inventory of surplus and obsolete propellants, currently in excess of 75,000 short tons. Environmental restrictions are significantly increasing incineration costs, with prohibition a potential occurrence. A need exists to develop an environmentally acceptable means of disposal. High temperature industrial processes offer one such opportunity. TPL is active in the demilitarization of explosives and propellants for both commercial and military applications. Concurrently, TPL is developing industrial processes which employ propellants as a fast release, gas source. This expertise provides the capability to develop an industrial process use for surplus propellants. Potential industrial processes will be identified and requirements compiled. Related end use properties of surplus propellants will be determined and matched with possible applications. Critical issues regarding the specific end use will be defined. Feasibility experiments to evaluate these issues will be performed. Alternate uses will be evaluated. Phase II recommendations will be formulated.

TRF TECHNOLOGIES, INC.
701 SE SALMON
REDMOND, OR 97756
Phone: (503) 923-0804
Topic#: 92-125 ID#: 92HDL-073
Office: HDL
Contract #: DAAL02-93-C-0014
PI: Kenneth Lakin
Title: Miniature Rugged RF Filters and Low Power Oscillators
Abstract: Future artillery launched systems will take advantage of high levels of circuit integration to achieve sophisticated signal processing capabilities in a small rugged package. Two areas that do not presently lend themselves to miniaturization are filters and oscillators. This project will develop miniature rugged RF circuits using thin film microwave acoustic bulk wave resonators and filters and a new rugged multi-chip module concept. The thin film resonator technology offers significant size reductions and high performance compared to ceramic or other conventional frequency control technologies. The Phase I tasks will demonstrate a high performance narrow band filter for use in fuzing and GPS telemetry application and design a low power oscillator using high performance microwave acoustic resonators to control oscillator frequency. The special issue of circuit packaging for the high G environment will be investigated and a rugged simple multi-chip module concept will be demonstrated in Phase I with more complex circuits fabricated during Phase II. Potential commercial applications include personal

communications systems and remote environmental sensor telemetry systems.

TRITON SYSTEMS, INC.
184 CEDAR HILL STREET
MARLBOROUGH, MA 01752
Phone: (508) 263-6636
Topic#: 92-134 ID#: 92MTL-212
Office: MTL
Contract #: DAAL01-93-C-4013
PI: R. Ross Haghighat
Title: Modified Resin Transfer Molding for Fiber Reinforced Ceramic Matrix Composites
Abstract: The proposed Phase I SBIR program will demonstrate a simple, reproducible, cost-effective and near net-shape approach to "transfer molding" of advanced fiber reinforced ceramic matrix composites using a revolutionary and entirely new process developed by scientists at Triton Systems, Inc. We have already successfully demonstrated the feasibility of this unique process. The proposed effort will expand this technology to better understand it's processing parameters and optimize this technique in terms of mechanical, physical and thermal performance of the final composite. The result will be complex-shaped, fiber reinforced CMC's which are designed to outperform CMC's processed by alternative processes. Our approach is based on "Resin Transfer Molding" (RTM) of organic matrix composites (OMC) which has been in use for several decades as a lower-cost alternative to autoclave curing and other labor and capital intensive processes used in high performance applications. The main advantages of this process are it's ability to deliver near-net-shape complex shapes in high volume and low cost with good surface topography. Other advantages include flexibility in tooling and materials, easy part consolidation through molded-in parts and fittings, fast production cycles and less than 2 percent voids. The Phase I program will optimize the process conditions, fabricate and characterize several fiber reinforced CMC specimens using a "Ceramic Transfer Molding" technique. The Phase II program will optimize the process for maximum strength, toughness and high temperature performance.

UBC, INC.
8405-A BENJAMINE RD.
TAMPA, FL 33634
Phone: (813) 884-6076
Topic#: 92-058 ID#: 92MIC-112
Office: MICOM
Contract #: DAAHO1-93-C-R093
PI: Patrick E. Crane
Title: Low Cost, Polarization Diverse MMW Integrated Antenna/Transceiver
Abstract: A unique dual polarized monopulse sensor configuration providing full compatibility with MLRS, Longbow, but also providing a means of extending polarimetry to low cost systems without sacrificing performance, is utilized to propose a nearly universal sensor head appropriate to both low and high performance systems. Extremely high levels of transmit-to-receive isolation are achieved while eliminating all RF components from the assembly.

ULTRALIFE BATTERIES, INC.
P.O. BOX 622
NEWARK, NY 14513
Phone: (315) 332-7100
Topic#: 92-114 ID#: 92ETD-047
Office: ETDL
Contract #: DAAL01-93-C-3310
PI: Dr. M.L. Gopikanth
Title: High Energy Density, Ultra-safe, Li-MnO2 Pouch Cell
Abstract: The Army is one of the major users of Li batteries, as they are reliable, have high energy density and shelf life. Present lithium systems are not safe and require special care and caution by the user. An ultra-safe, high rate, high energy density Li/Mn02 cell packaged in soft pouch material is being proposed for development of BA-5590/U cell. This new system is safe, low cost and has potential to replace all of the present primary cells/batteries used by the Army. A Phase I program to prove the feasibility of BA-5590/U cell with Li/MnO2 chemistry and U.B.I.'s patented safety separator, and package with a soft pouch material is proposed. During this program, work will focus on hermetic sealing, manufacturing process and fabrication of high rate cathode. Also, assembled cells will be evaluated for electrical performance and safety. U.B.I is uniquely qualified to conduct this program, as we have in place a manufacturing process necessary for manufacture of Li/Mn02 batteries and own a safety-shutdown separator process. During Phase II, U.B.I. will fabricate BA-5590/U cells and assemble them into a battery, then evaluate the battery for electrical performance and prove use of Li/MN02 chemistry and soft pouch packaging material to replace present chemistry. An ultra-safe, high rate, high energy density battery with low cost is desirable to Army to reduce their cost without sacrificing safety, reliability and performance.

ULTRAMET
12173 MONTAGUE ST.
PACOIMA, CA 91331
Phone: (818) 899-0236

Topic#: 92-003 ID#: 92ARD-019
Office: ARDEC
Contract #: DAAA21-93-C-0036
PI: Andrew J. Sherman

Title: Advanced Materials and Fabrication Processes for Gun Barrels

Abstract: High rate of fire, high velocity, medium-caliber (20-, 25-, and 30-mm) gun barrels have been used extensively by U.S. Armed Forces over the past 20 years. A major problem with such systems is that the barrel must be replaced far too often due to excessive wear and corrosion at the breech end, which limits weapons system accuracy and dramatically accelerates with extended high-rate-of-fire bursts and/or higher energy propellants. In this Phase I program, Ultramet proposes a baseline solution to this generic problem through the use of rhenium inserts. Refractory metals and alloys and fabrication process will be evaluated for cost, performance, and compatibility improvements over the baseline rhenium and tantalum/tungsten (Ta-10W) alloys. A rhenium insert will be fabricated for actual gun performance validation to provide a baseline high coatings and will be subjected to wear and erosion testing using verified methods for comparison to current stellate and chrome-plated steel barrels and the baseline rhenium and Ta-10W materials.

ULTRAMET
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PACOIMA, CA 91331
Phone: (818) 899-0236

Topic#: 92-053 ID#: 92MIC-065
Office: MICOM
Contract #: DAAHO1-93-C-R121
PI: Andrew J. Sherman

Title: Solid Rocket Booster (SRB) - Based Starter System

Abstract: In this Phase I program, Ultramet proposes to demonstrate the feasibility of using a modified solid rocket booster (SRB) to provide the hot gas cranking and ignition source for starting a small turbojet sustained engine, in addition to boost propulsion. This SRB-based starting system would replace the pyrotechnic starter cartridge currently used as a gas generator and ignition source for the sustained engine, thereby reducing both the cost and weight of the total system without sacrificing performance. The primary difficulties involved are fivefold: reducing the 5000 R, 1500-psia SRB flame to conditions that will not damage the turbine rotor; maintaining sufficient gas velocity, pressure, and mass flow to the impingement nozzles to successfully start the engine, taking into consideration pressure losses due to gas cooling and frictional effects; demonstrating materials of construction capable of surviving the erosive, high temperature propellant gas; modifying the SRB to account for pressure and heat losses due to gas diversion; and possibly filtering carbon, alumina, and other condensible matter from the hot gas stream before its introduction into the turbine section. This program will demonstrate a workable design capable of surmounting these obstacles through theoretical calculations and hardware demonstration of a SRB-based starter system.

UNISTRY ASSOC., INC.
129 N. EAGLE ROAD
HAVERTOWN, PA 19083
Phone: (904) 392-7572

Topic#: 92-020 ID#: 92AVS-111
Office: AVSCOM
Contract #: NAS3-26923
PI: Dr. William E. Lear

Title: Advanced Wave Rotor, Fluid-fluid Energy Exchanger

Abstract: A gas turbine engine concept is proposed that provides the technical innovation needed to increase specific power, thermal efficiency, and overall performance and reliability without need for development in material technologies. This advanced fluid-fluid energy exchange device can serve as the core of high performance gas generators to meet a variety of land/air applications. This unique system is based on unsteady flow phenomena which produces the functional equivalent of a coupled gas turbine and compressor by continuous expansion of one gas stream while extracting energy which is used to compress another gas stream. The wave processes occur within one rotor which features canted blades that are alternately exposed to hot and cold fluids resulting in material temperatures much lower than peak cycle values. The proposed program features the modification of an existing CFD code, that has been developed to investigate the wave processes within a rotor cell, to include blade angle and cell area change effects, and exercise the code to determine optimum rotor and performance characteristics suitable for laboratory test rig. A unique concept will be defined for a cold flow laboratory test rig that features flexibility, modularization, ability to accommodate test diagnostics, and be economical. Moreover, the design will allow for first and second stages of the expansion/compression processes to be investigated without need for high temperature combustor gases.

UNITED SIGNALS & SYSTEMS, INC.
P.O. BOX 3435
RANCO PALOS VERDE, CA 90274
Phone: (310) 838-3369
Topic#: 92-041 ID#: 92SW-021
Office: CECOM
Contract #: DAAB10-93-C-0005
PI: Dr. M. Shiva
Title: Noise Reduction Techniques Using Higher-order Spectra
Abstract: This project will address the development of noise reduction and narrowband/wideband interference cancellation techniques that are needed to support wideband communication systems. Underscoring this effort are advanced signal processing algorithms based on higher-order cumulants or spectra (HOS) techniques, such as the trispectrum. HOS-based techniques have shown great promise in terms of accuracy, robustness and performance improvement over autocorrelation (or power spectrum) -based methods in the face of statistical uncertainties of communication environments. Consequently, the development and application of HOS-based algorithms to noise and interference reduction problems that arise in wideband communications has become timely. Four directions are covered during this exploratory development: (1) utilization of HOS-based Time-Frequency Distributions for the identification and cancellation of narrowband/wideband interferences; (2) development of HOS-based methods for the suppression of additive Gaussian noise (generally colored and possibly spatially correlated); (3) evaluation of the performance of the HOS-based methods against varying SNRs, SIRs, as well as different noise/interference characteristics; (4) development of a Reduced Complexity Algorithmic Architecture (RCA2) and assessment of algorithmic complexity.

UTILITY DEVELOPMENT CORP.
112 NAYLON AVENUE
LIVINGSTON, NJ 07039
Phone: (201) 994-4334
Topic#: 92-132 ID#: 92MTL-127
Office: MTL
Contract #: DAAL01-93-C-4039
PI: Harry S. Katz
Title: Latex Coated Fabric for CB Protective Applications
Abstract: During the Phase I program, we propose to develop latex coated cloth that will have good permeation barrier and decoy characteristics, with ease of processing and capability of high volume production at low cost. We will coat fabrics with various types of latex materials. We will also study various defoamers and fillers in the latex materials to improve the performance of latex coatings. These coated fabrics will be tested for adhesion between the latex layer and fabric. Tests will also be conducted after long-term exposure to a QUV Weatherometer. Chemical agent testing will help us to determine the best materials for producing masks, hoods, and garments. During Phase II of this program, we will develop and demonstrate a continuous process for production of materials demonstrated in the Phase I program. We will demonstrate large-scale producibility of BCC using the latex process by producing sample rolls of materials meeting MIL-C-51251A and MIL-C-12189H not less than 30 inches in width. We will also produce samples of prototype garments.

VEXCEL CORP.
2477 55TH STREET
BOULDER, CO 80301
Phone: (303) 444-0094
Topic#: 92-088 ID#: 92TAC-137
Office: TACOM
Contract #: DAAE07-93-C-R028
PI: James Curlander
Title: Image-based Terrain Database Generator for Simulation
Abstract: Vexcel Corporation together with Hughes Training, Inc. Advanced Systems Facility proposes a multi-source terrain database generator for the Vetronics Crew Display Demonstrator system. The system would incorporate information from existing VCDD databases, mapping products, and new imagery to produce digital terrain models and environments for combat vehicle simulation. The system would be hosted on a high speed graphics workstation such as the Silicon Graphics Iris family of computers, to take advantage of the state of the art in display and visualization technology. A Unix / C software environment would be used, and the systems interface would be integrated into the VCDD interface development software. Also the VCDD Systat software capabilities would be used. The resulting prototype will prove feasibility of image-based extensions and enhancements to the current VCDD terrain database simulation capabilities.

VHDL TECHNOLOGY GROUP
974 MARCON BLVD., SUITE 260
ALLENTOWN, PA 18103
Phone: (215) 266-9791
Topic#: 92-112 ID#: 92ETD-002
Office: ETDL
Contract #: DAAL01-93-C-0271
PI: William D. Billowitch

Title: Very High Speed Integrated Circuit (VHSIC) Hardware Descriptive Language (VHDL) Package Library/Common Packages

Abstract: While there are already a number of packages available either in the public domain or commercially, there are numerous classifications of design techniques and areas in which additional VHDL packages would benefit the industry. These include: (a) Back-Annotation, (b) Math routines, (c) Floating-Point, (d) Digital Signal Processing Functions and (e) Abstract Queuing. In Phase I of the proposed work, a survey of the most needed packages will be conducted and a specification will be written to further develop the packages under Phase II. Therefore the goals are: 1. Develop an industry survey asking users to describe the features in any of the packages mentioned above and gain feedback on requirements for packages other than those identified based upon the industry's needs. 2. Develop a draft specification for each package. In those cases where the functionality can be so well defined as to specify the procedural interfaces, this specification may be as detailed as a VHDL package declaration, or alternatively the specification may describe the subprograms and types needed in the abstract and leave the detailed design for Phase II. This effort will be accomplished in coordination with the efforts of the IEEE and the industry with the goal of providing VHDL packages not readily available elsewhere.

VIASAT, INC.
6120 PASEO DEL NORTE, SUITE J2
CARLSBAD, CA 92009
Phone: (619) 438-8099

Topic#: 93-016 ID#: 93MIC-006
Office: MICOM
Contract #: DAAHO1-93-C-R317
PI: Gary Echo

Title: Teleoperation and Unmanned Systems/Robic Enhancements

Abstract: The goal of this proposed multiphase SBIR program is to build and demonstrate Multiple Vehicle Cooperative Control Subsystem (MVCCS) for autonomous, optimal positioning of several Unmanned Ground Vehicles (UGVs) working together. By facilitating the ability of UGVs to share information and adaptively optimize their relative positions based on specific goals, the MVCCS can act as a significant force multiplier for a wide variety of missions. Mission goals which can benefit from such a capability include things like communications link optimization and relay for extended range, cooperative path finding, interactive target recognition and position location, cooperative EW (e.g. jamming or spoofing), and cooperative reconnaissance. Overall UGV mission reliability should also be greater improved by the ability to autonomously and mutually adapt to changing mission situations such as enemy movements, jamming or spoofing. Phase I will establish the requirements and architecture of the MVCCS as well as implement an interactive simulation for demonstration, evaluation and concept validation. Phase II will result in a fully capable prototype of the MVCCS targeted for a Vetronics implementation using existing UGV processors and communications networking capabilities to the maximum extent possible.

YANKEE SCIENTIFIC, INC.
93 WEST STREET
MEDFIELD, MA 02052
Phone: (508) 359-7999

Topic#: 92-070 ID#: 92NAT-095
Office: NATICK
Contract #: DAAK60-93-C-0022
PI: Dr. Eric C. Guyer

Title: Nonpowered Instant Water Heater

Abstract: The development of a non-powered, instantaneous, pressurized supply water heater for field use will be developed based on the use of established R-tube diesel fuel burner technology and one of several possible two-phase direct steam-water pumping concepts. The direct steam water pumping concepts to be considered are a "chugger" pump which has been recently studied at Massachusetts Institute of Technology, the condensing ejector pump which as been used in a variety of industrial applications, and the pulse pump which is commonly used in food preparation appliances. All concepts for providing the pumping action are based on the use of atmospheric or low pressure steam as the motive force for pumping and involve simple mechanical arrangements with no moving parts, except for possible check valves. The vest direct two-phase pump type for application to the army requirements will be selected. An overall engineering design will be established and a proof of concept device will be built and tested. The proposed system has a probability of successful development since it is based on the combination of existing burner and two-phase pumping technology.

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ARMY Topic#: 92-172
AERONIX, INC.
HUNTINGTON RESEARCH AND ENGINEERING
INTELLIGENT REASONING SYSTEMS

ARMY Topic#: 92-173
KTECH CORP.
RADKOWSKI ASSOC.

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ARMY Topic#: 93-020
SIMULA, INC.

ARMY Topic#: 93-021
PHYSICS & ENG. RES. (PER)

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MICHAEL & ASSOC., INC.

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ADVANCED FUEL RESEARCH, INC.

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CEMCOM RESEARCH ASSOC., INC.
DUNCAN TECHNOLOGIES, INC.
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ORBITAL RESEARCH, INC.

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